DOCTORAL THESIS

An Investigation into the Relationship Between Intended and Actual Learning in Key Stage 3 Design and Technology Lessons

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An investigation into the relationship between

***intended* and *actual* learning in Key Stage 3**

Design and Technology lessons

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This thesis is dedicated to:

My twin sister, Sarah

For **wholly** believing in me and **forever** supporting me

My partner, Kevin

For providing me with the space, support and love

I needed to start and finish this journey

And

Enid and Maurice Southall, my Mum and Dad

Thank you for making me the person who was capable of doing this

Abstract

This thesis investigates the planning processes involved in transforming *intended* learning into *actual* learning. It focuses on the nature of, and influences on, the planning process and in particular, the extent to which the relationship between *intended* and *actual* learning supports the teaching-learning process in Design and Technology. The planning processes and procedures used by teachers are an essential pre-requisite to ensuring students' progress their learning and consequently a vital aspect of teaching. Unfortunately however, it is an area of teaching often only considered in the context of 'novice' teachers. With the recent increasing focuses on the production of measurable learning 'outputs' in education, understanding the mechanisms behind effective planning processes that provide appropriate learning experiences, producing a range of learning outcomes is challenging for teachers and schools.

This empirical research study adopts an interpretivist framework, utlising multiple data sources to collect both qualitative and quantitative data. Three distinct, yet inter-connected studies provide the structure for the main study: Study 1 analyses 47 lesson plans and identifies the key operational requirements of, and themes within, current planning processes, Study 2 involves seven lesson observations, identifying and examining the *intended* learning and the *actual* learning, and Study 3 asks participants to identify the learning that is demonstrated in the learning outcome and then compares this to the *intended* learning statement.

The findings from this study reveal that the dominant, systematic planning model used by many teachers, provides only to a limited extent the relational framework for the *intended* and *actual* learning that supports the teaching-learning process. The prevailing focus on learning outcomes identified during this research is, it is argued, unable to fully support the multidimensionality and multimodality integral to Design and Technology learning. Instead it is restrictive and promotes a limited approach to the subject in relation to both teaching and learning.

The study concludes that the planning processes and procedures in Design and Technology need to

be developed with the clear intention of strengthening their role within the teaching-learning process. This would encourage the development of the underlying important principles inherent within the subject and support teachers' and students' achievement, creativity and enjoyment in teaching and learning in the classroom.

Abbreviations and technical terms

ELO	*Episodic Learning Outcomes*
ILS	*Intended Learning Statements*
LJCM	*Learning Journey Concept Map*
OBE	Outcome Based Education
KLT	Key Link Teacher
TLRP	Teaching and Learning Research Programme
ASLO	Assessment of Significant Learning Outcomes
ESRC	Economic and Social Research Council

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Chapter One: Introduction

1.1 The background context

This journey started in 2007 when I was asked to work on the Qualification and Curriculum Authority's (QCA) *National Exemplification of Standards* project[1] as the Design and Technology Coordinator. The key goal of the project was to support teachers in their standardisation and moderation processes and procedures by providing a wide range of student work that exemplified the attainment levels, 3-8. As the coordinator, I was responsible for gathering and collating the information to populate the web-based resource with Key Stage 3 examples of teaching and learning from students aged 11-14 years.

QCA identified five schools to participate in the project and recommended certain teachers who were considered experts in the practice of Design and Technology education. The teachers were asked to plan a six-week unit of work that was original and creative and referenced directly to the New 2007 Secondary Curriculum materials (DCSF/QCA, 2007). The teachers were given a detailed lesson planning pro forma designed to clearly identify the key concepts, key processes, range and content and curriculum opportunities to be covered (see Appendices C and D).

This planning phase was particularly difficult, with the teachers struggling to identify the key concepts and translate these into a classroom setting. It took two months longer than anticipated, presumably due to the teachers' unfamiliarity with the process and the new curriculum model. Several issues became apparent during this phase of the project. The teachers planned their lessons

[1] The *National Exemplification of Standards* project (2008) provided the materials needed to support the roll out of the APP strategy (Assessing Pupils' Progress). APP was developed by QCA as a national approach to assessment.

in terms of ‘doing’ rather than ‘learning’ and found it difficult to identify the learning associated with the ‘doing’ activity. The *intended* learning statements were often general or ambiguous statements about learning, resulting in a range of interpretations; the teaching and learning activities, meanwhile, often lacked challenge and creativity and tended to be based upon ‘typical’ and familiar activities in Design and Technology classrooms.

Once the teachers had delivered the unit of work, learning outcomes, generally photographs or scanned images of students’ work produced during the lessons were gathered and sent to me digitally. Detailed commentaries from the teacher accompanied the learning outcomes, explaining the attainment level awarded to each student’s work. Attainment levels are descriptions of the knowledge, skill and understanding which is expected to be characteristic of eight levels of attainment for each National Curriculum attainment target (DCSF/QCA, 2007); they are used for assessment procedures in which teachers judge the ‘best fit’ of level descriptors with known pupil attainments.

The teacher commentaries were of particular interest to me as I hoped they would provide clarification and, in particular, an explanation of the learning exemplified or demonstrated in the learning outcome and validate the awarded attainment level (see Appendix B). However, rather than enhancing the learning outcomes, the commentaries either described, often in detail, the image(s) of the student’s work or merely presented the production method associated to the learning outcomes. For example, an image of a final product included a commentary on what the product was made from, how it was made, how it was finished and how hard the student had worked to produce the product. A page of initial ideas by the student was often accompanied by a commentary on the range of creative ideas represented. Although teachers often referred directly to the attainment levels or relevant sentence in the attainment level, the teacher often did not justify how the attainment level was demonstrated through the learning outcome; that is, the application or integration of the attainment level in relation to the learning outcome was often neglected.

Further issues arose at this stage in the exemplification process. The learning outcomes tended to be either written or practical examples and were rather predictable; the learning outcomes often did not exemplify the *intended* learning specified in the original lesson plan; that is, it was often difficult to relate the *intended* learning and the *actual* student's learning. Furthermore, teacher assessment of the learning outcome was inconsistent and unreliable, when the learning outcomes were the sole source of evidencing the learning.

The teachers appeared to encounter problems when the focus was on identifying and describing Design and Technology learning. One key question that emerged was: 'What does Design and Technology learning look like?' Such a fundamental question has significant implications on the teaching-learning process and, in particular, how teachers identify the learning they want their students to achieve and how they plan to allow students the opportunity to demonstrate it. It appeared that the difficulty (and, therefore, a probable explanation) was related to the planning processes and procedures teachers were using. This was the 'seed' from which this thesis grew.

1.2 Formulating the research problem

Planning for *classroom-based learning* takes place in the 'pre active' phase (Jackson, 1968; John, 1991) of the teaching-learning process and traditionally requires the teacher to undertake a process that is structural in conception and, as such, relies on a 'systems' approach to planning (Cherryholmes, 1988). 'Planning is an activity in which all teachers engage and is central to their teaching' (John, 2006: 301). The planning process aims to provide the opportunities for students to progress in their learning. The Teachers' Standards (DfE, 2011b: 10) for all teachers states that a teacher must 'be accountable for pupils' attainment, progress and outcomes; be aware of pupils' capabilities and their prior knowledge, and plan teaching to build on these; and, guide pupils to reflect on the progress they have made and their emerging needs'. The 2007 National Curriculum for England provided the framework for the planning processes and procedures investigated in this research study (DCSF/QCA, 2007).

Constructed within an Outcome-Based Education (OBE) framework, the 2007 National Curriculum for England and associated National Strategies programme promotes a prescriptive, tightly specified and sequenced 'systems' approach to teaching and learning (Swaffield, 2009). Such an OBE approach places the focus on evidencing learning and measuring learning progress. In secondary schools, 'a learning outcome sets out what a learner is expected to know, understand and be able to do as the result of a process of learning' (DfE, 2014a)[2]. Learning outcomes, defined in this way, are generally the product of 'formal' or 'deliberative learning' (Eraut, 2000), defined throughout this research as *classroom-based learning*. The outcome or evidence of students' learning needs to demonstrate or represent the learning that has taken place in order for teacher assessments to be reliable (Mansell, James and ARG, 2009). The specification of learning and the use of learning outcomes as indicators of learning allow teachers to focus their teaching and assessment practices and can provide effective support for the teaching-learning process (Hussey and Smith, 2002). Thus, the teacher needs to have a clear intention to bring about learning, to understand where the learners are in their learning, and a consideration of the nature of that which has to be learnt (Wiliam, 2000).

Design and Technology is a relatively new inclusion in secondary education, having been introduced into the first National Curriculum in 1990 for England, Wales and Northern Island and, as such, has had limited time in which to become established (DES/WO, 1990). The material-focus areas, designing and making aspects of the subject, and processes involved, require both an

[2] The DfE definition of a learning outcome (4 February 2013)

interdisciplinary and multidisciplinary approach to learning progress (Wilson and Harris, 2004), resulting in a breath of skills, knowledge and understanding that are hard to specify in terms of a distinct content. Kimbell and Perry contend that the subject is 'a creative, restive, itinerant, non-discipline' (Kimbell and Perry, 2001: 6) and, as such, demands a degree of responsiveness, flexibility and creativity from the National Curriculum.

In this thesis, Design and Technology education provides the lens by which to observe and investigate the translation of policy into practice in England. By investigating the prescriptive 'systems' approach embedded in the 2007 National Curriculum, in the context of Design and Technology learning progress, a greater understanding of the effectiveness of such a system, on a particular subject area is sort. Teacher commitment to such a tight pedagogical framework has been varied and changes to classroom practice have been slow to embed (Ofsted, 2010). The tension between policy and practice can be seen throughout the teaching-learning process and is particularly pertinent in relation to the planning phase.

1.3 The boundaries of this research study

The process of teaching and learning is a difficult, unpredictable, dynamic interaction between student and teacher (Pring, 2000), and provides a complex environment for any epistemological research study. This research study is situated within the relationship between teaching and learning, and is based upon the belief that enhancing student learning is a direct result of enhancing teaching practice. Contemporary theories of learning are presented with reference to more traditional learning paradigms. The concept of a learning continuum is proposed, highlighting the narrow range of learning associated with *classroom-based learning* opportunities. Translated into a 'teaching-learning continuum' (Zurcher, 2010), teaching and learning can take place across the entire range of contexts from 'informal' to 'formal'. This research study investigates *classroom-based learning* and is, therefore, situated in the 'formal' range.

The processes teachers use to plan for learning lie at the center of a 'systems' approach to teaching and learning, and are the focus of several recent research studies (Hussey and Smith, 2003; John, 1991; 2006). Planning is often discussed in relation to formative assessment processes or in relation to training novice teachers. John (1991; 2006) provides a variety of insights into planning processes, including its purpose and function. However, unlike this study, research tends to focus upon generic planning processes and is unlikely to provide a detailed review of any specific planning processes and procedures. In order to address both national and international readership, the scope of this research study reaches further than the educational policies and practices in England, and includes *classroom-based learning* associated with students aged 11-14 years old, Design and Technology teaching and learning and learning outcomes and, OBE and 'OBE-influenced' systems, exploring impact on learning progress and student achievement.

1.4 The aim of this research study

This research study investigates the relationship between *intended* learning and *actual* learning in Key Stage 3 Design and Technology classrooms, with an emphasis on teacher practice. Pre-specified learning outcomes *fuel* the design of students' learning experiences, and the effectiveness of the learning journey is determined by exploring the degree of match between the *intended* and *actual* learning outcome. Set within a Design and Technology context, this research investigates how teachers identify and formulate Design and Technology learning, how they provide appropriate opportunities for students to develop in relation to the *intended* learning, and investigates how teachers ensure evidence of learning progress is produced. This research study will include a comparison between the 'pre active' and 'inter active' teaching perspective in order to relate *intended* and *actual* learning. The following sub-research questions, developed from my reflections on the *Exemplification of National Standards* project, provide the information needed to explore the relationship between *intended* and *actual* learning:

- To what extent does Design and Technology teachers' planning achieve the *intended* learning outcomes?
- To what extend do the *intended* learning statements enable the *intended* learning to be achieved?
- What methods are used to capture and gather evidence of students' learning in Design and Technology?
- Does the evidence of learning produced in Design and Technology lessons demonstrate the *intended* learning?

1.5 The structure of this thesis

The thesis is presented in three sections. Section 1 includes Chapters Two, Three and Four and provides a review of the current literature in relation to learning and planning in secondary school classrooms. In particular, Chapter Two provides a background to learning theories, paradigms and approaches, with particular reference to *classroom-based learning*. Chapter Three focuses upon learning associated with Design and Technology education and the policy frameworks that provide the structure for teaching and learning in Design and Technology. Chapter Four reviews the current literature on planning to achieve learning, specifically examining planning for *intended* learning and *intended* learning outcomes. Section 2, Chapters Five and Six, guided by the key discussions highlighted in Section 1 presents a detailed discussion on the research methods and methodologies used in this research study. Analysis of the results and key findings are presented in Chapter Six. The final section, Section 3, includes Chapters Seven and Eight. Chapter Seven comprises a detailed discussion of the findings in relation to the key themes that emerged in Section 1 and the research findings, then answers the research questions and concludes with a discussion on the implications of this research. Finally, Chapter Eight highlights the recent education policy changes and their implications on the findings and on classroom practice and future research.

Chapter Two: *Classroom-based* Teaching and Learning

Classroom-based teaching and learning presents a complex subject for enquiry involving a wide variety of interrelated and integrated factors. Learning is infused with the complexity of learners' lives and is created through constant negotiations between individuals, social environments and broader social influences. The classroom environment and the interactions between teaching and learning, with all their complexities, provide the setting of this investigation.

The motivation behind this research study developed from a personal and professional need to provide usable, realistic and manageable advice for teachers on how best to approach the planning process in order to ensure accurate and authentic evidence of learning progress. As Howe and Moses (1999: 34) contend, educational research should be 'for teaching' and not simply 'on teaching'.

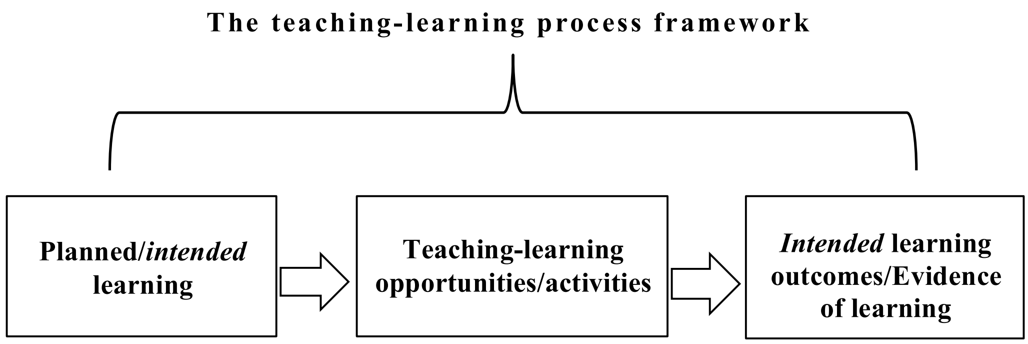
Through interrogating the literature on *classroom-based learning,* this chapter reviews the main discussions relevant to this research study's topic and explores the theories behind the *intended* learning that is planned to take place during a lesson or learning journey and. A common analogy within education, referencing learning to a journey (Peters, 1965), is used throughout this research study and refers to the learning progress through a *classroom-based learning* opportunity or lesson. The term 'learning journey' is used to complement the research study's focus upon learning intentions and learning outcomes; that is, 'where you want to go' and 'how will you know you are there'. The dominance of the measurement paradigm in relation to assessment and the objective's concept of learning align to the notion of a learning journey. An intentional learning environment has a directed purpose in that it has goals and objectives on what and/or how to learn (Good and Brophy, 1990).

Intended learning is synonymous with *classroom-based learning*, with a focus on the learning intention of a series of learning activities. Teachers need to be clear about the *intended* learning in relation to the overall lesson, as well as the various learning activities that provide the learning journey, in order to plan for the progress of their students' learning over a period of time (Black and Wiliam, 1998). Clearly, learning progress is relative to a particular student's starting point in the learning process; however, with careful planning a teacher can ensure all students progress in the intended knowledge, skills and understanding systematically during a lesson duration (Ofsted, 2014a). Indeed, all students' learning and, therefore, learning progress needs to be measurable; particularly given that 'rapid and sustained progress' is the Office for Standards in Education, Children's Services and Skills' (Ofsted) key indicator for success (Ofsted, 2012: 4). Thus, teachers plan to provide learning opportunities and *create* evidence of learning in both 'accessible' and 'assessable' forms.

The complexity of the learning process means it is something that cannot always be easily isolated or exemplified; that is, learning is often neither 'accessible' nor 'assessable' (Moloney and Harbon, 2010). Learning progress, or the process of learning, by its very nature, is difficult to 'confine' to a single location or moment in time (Hewitt, 2008). It involves wider psychological, biological and social conditions and many processes and dimensions, learning types, learning barriers and specific internal and external conditions (Illeris, 2009). Nuthall (2008) posits classrooms are multilayered environments with students learning, often simultaneously, on a variety of different dimensions. However, evidence that learning has taken place and the concept of a *learning outcome* is commonplace in any classroom setting and is necessary and fundamental when assessing learning progress. Teachers are required to be explicit about the nature of the learning they provide through the process of planning the learning and during the learning opportunities (the *intended* learning and the *actual* learning) (Jackson, 2003).

The research questions addressed in this research study focus primarily upon the planning phase of the teaching-learning process, however the inter-relationship between the phases of the teaching and learning process provide essential information on which to address the sub-research questions. Figure 2.1 below provides a schematic representation of the focus areas of this research study and is adapted from Snape's framework for quality teaching and learning (Snape, 2013). Snape argues that the success of the framework is a combination of students understanding the *intended* learning, the use of authentic pedagogy and a strong formative assessment regime, that both informs students on their learning progress and uses learning outcomes as 'evidence of achievement' (Snape, 2013: 144).

Figure 2. 1 The teaching-learning framework (adapted from Snape, 2013: 140)



The three phases presented in Figure 2.1 provide the basic theoretical and structural framework for this research study. The inter-relationship between the three aspects of the teaching-learning process is important, as each phase is influenced and affected by the other two phases. It is necessary to recognise the dynamic and organic nature of the teaching-learning process (Pring, 2000).

In order to fully address the research questions, the concept of learning and, specifically, *classroom-based learning*, are reviewed in sections 2.1 and 2.2. The main learning paradigms provide a 'conceptual lens' by which to examine *classroom-based* teaching and learning in detail, within the overall context of an exploration into the concept of planning for learning, and particularly planning for Design and Technology teaching and learning.

2.1 Defining learning

Frequently defined as a relatively lasting change in behaviour, often the result of experience (Tolman and Gleitman, 1949; Gredler, 1997; Huitt and Hummel, 2006), Illeris (2009) argues that the concept of learning involves an extensive and complicated set of processes. Therefore, a broad explanation is not only most suitable, but it is also useful when creating a definition. Thus, Illeris defines learning as:

…all processes that lead to relatively lasting changes of capacity, whether they be of a motor, cognitive, psychodynamic (i.e. emotional, motivational or attitudinal) or social character, and which are not due to genetic-biological maturation (Illeris, 2003: 398).

Although much of Illeris's research into learning is situated in professional/workplace contexts it could be argued his theory on learning is a form of 'meta-theory', in that it brings together the work of many other learning theorists as a form of 'synthetic theory'. As such, Illeris's theory on learning is reviewed and used as a comparative throughout Section 1 of this thesis.

Eraut provides an explanation that is more closely aligned to *classroom-based learning,* arguing that learning is:

…the process whereby knowledge is acquired. It [learning] also occurs when existing knowledge is used in a new context or in new combinations: since this also involves the creation of new personal knowledge, the transfer process remains within this definition of learning (Eraut, 2000: 114).

Eraut defines personal knowledge as a 'cognitive resource', inferring that learning is a personal experience that guides both thinking and performing, and can be used in any social situation (Eraut, 2000: 115). Although Eraut's use of the word 'acquire' infers no particularly active, emotional or social involvement in the learning process, his definition of 'personal knowledge' indicates a degree of participation. Hence, his explanation for learning has a similar emphasis to the 2007 National Curriculum, with the key focus on acquiring knowledge, skills and understanding and an underlying 'awareness' of the emotional and social requirements for learning. In addition, his emphasis on 'transferability', that is transfer of learning from one context to another, can also be referenced to the 2007 National Curriculum through the promotion of 'transferable skills' (DfES, 2004c: 22). Eraut's definition offers teachers a recognisable and familiar learning description and, for this reason, this research project adopts his definition of learning.

2.1.1 Defining and describing *classroom-based learning*

Classroom-based learning, often termed 'formal learning' or 'school-based learning', can be described as learning that involves and is generated by a teacher-student relationship in a classroom environment (Bell and Dale, 1999). Whilst this teacher-student relationship will not be examined in detail, the relationship between the planned learning activities managed by the teacher and the learning outcomes planned by the teacher, but produced by the student, will reveal important clues as to the nature of the teacher-student relationship and consequently the teacher's approach to planning.

The term 'formal learning', as opposed to 'informal' learning, tends to focus on either the purpose or objectives of the learning or the learning setting (Brookfield, 1983). A simple distinction can be drawn between 'formal' and 'informal' learning in relation to who controls the learning objectives and goals. In 'formal learning' environments, the teacher or department sets the goals and objectives, whereas 'informal learning' requires the learner to set their own goals and objectives (Cofer, 2000). In regards to *classroom-based learning*, the teacher is responsible for controlling and managing the learning, albeit within a set pedagogical framework, through formulating the learning intention and identifying the learning outcome. Whilst such a simple distinction between 'formal' and 'informal' learning ignores any consideration of processes that may be involved in learning, once the learning intention has been defined, and neglects the importance of the teacher-student relationship, it does provide a description of the 'formal' education system that locates this research study.

Eraut (2000: 114) presents the following five characteristics to support a broad definition of 'formal' learning:

- the presence of a designated teacher or trainer;
- a prescribed learning framework;
- an organised learning event or package;
- the award of a qualification or credit;
- the external specification of outcomes.

Eraut recognises that any one of the characteristics could be located in a 'formal' domain and his characteristics help to provide further clarification of the meaning of 'formal' learning, and are particularly useful when considered in relation to the planning processes and procedures required for 'formal' learning and the components or criterion of a 'formal' learning outcome.

2.2 Learning paradigms

Learning theories are conceptual frameworks describing how information is absorbed, processed, and retained during learning. Cognitive, emotional, and environmental influences, as well as prior experience, all play a part in how understanding is acquired or changed, and how knowledge and skills are retained (Ormrod and McDevitt, 2013). Although there is no single available general account of learning – or, indeed, *classroom-based learning* – research into learning processes, whether from a neuroscience, cognitive psychology or educational perspective, provides an increasingly more complex understanding of what learning involves and the requirements for learning (RS, 2011). Developments in theories and views on learning are inevitably manifested as trends in, and influences on, teaching and learning in schools, apparent through ‘learning to learn’ initiatives, ‘learning styles’, ‘multiple intelligence’ and ‘lifelong learning’ teaching materials evident in classrooms in England.

Indeed, there are various ways of conceptualising learning (Hager and Hodkinson, 2009) and, in particular, *classroom-based learning* and associated teaching. Traditionally, learning theories tend to fall into one of three perspectives, paradigms, or ‘conceptual lenses’: behaviourism, cognitivism, and constructivism. Although distinct in their philosophy, in reality learning theories are difficult to directly isolate within education systems and difficult to translate into pedagogy (Garnett, 2013). Thus, teaching strategies, curriculum frameworks or learning activities may be derived from, based upon, or supportive of a certain perspective (McLeod, 2013), and several views on learning might be present in the classroom at any one time, as a dynamic mixture (Watkins, 2011). Design and Technology education requires several specific approaches to learning and teaching, which are discussed in Chapter Three (pp. 45-80) and relate to the ‘designing’ and ‘making’ activities and their pedagogical considerations. Reviewing the learning theories of the various writers will provide the context in which to investigate *classroom-based learning* associated with Design and Technology.

2.2.1 Learning and the behaviourist paradigm

The prevailing behaviourist view of learning involves a ‘passive process of knowledge acquisition’ (Watkins, 2003: 11). Knowledge in general and, more specifically, subject matters, are viewed as transferable commodities. As Baets (2006) explains, ‘a student (a learner) is seen as a vessel positioned alongside a “loading dock”. “Knowledge” is poured into the vessel until it is full. Whereas the student is the empty vessel, the teacher is a crane or a forklift. The teacher delivers and places knowledge into the empty vessel’ (Baets, 2006: 60). In the same way, Freire’s (1970) ‘banking education’ model involves expert teachers depositing knowledge into the student who lacks knowledge. The prevailing pedagogical metaphor in relation to behaviourism is a transfer metaphor.

From a cognitive psychology perspective, the concept of transfer of learning has long been seen to be of central importance. Transfer of learning occurs when learning in one context, or with one set of materials, impacts on the performance in another context or with other related materials (Perkins and Salomon, 1992). The concept of ‘transferable knowledge and skills’ has been a regular concept in the National Curriculum documentation since the Education Reform Act 1988, albeit having varying emphasis. In support, Watkins (2003) suggests that, whilst much of the formal arrangement of schooling is built on a behaviourist view of learning, it can be argued this is primarily due to policy-makers’ adherence to notions of learning transfer.

Design and Technology education is acknowledged as a multidisciplinary subject with a potential for cross-curricular activity (Wilson and Harris, 2004), and transferability of key skills is often attributed to the value of the subject. The 2007 National Curriculum, with reference to ‘curriculum opportunities’, requires linkage ‘between design and technology and other subjects and areas of the curriculum’ (DCSF/QCA, 2007: 57), however the claim that Design and Technology learning has ‘transferable skills’ can be questioned (Owen-Jackson, 2002). Although the notion of learning transfer has been important in the development of learning theory, Hager and Hodkinson (2009) contend, the research findings over the past decade clearly show that, in classroom environments, transfer of learning is difficult to achieve and they reject the metaphor of learning transfer on three grounds. Firstly, it presents a misleading way of understanding learning; secondly, it over-emphasises the importance of educational knowledge; thirdly, it is damaging and ‘even dangerous in practice’ (Hager and Hodkinson 2009: 20). Indeed the concept of learning transfer has largely been discarded in the learning transfer literature (Hager and Hodkinson, 2009), however as Pring (2000) argues, much of the contemporary educational policy makes assumptions about learning that are directly contradicted by current research and theorising of learning. This research study will identify tension between Government policy and teacher practices in the classroom as teachers strive to provide evidence of learning.

Behaviourism assumes, with reference to the learning process, that a complex skill can be taught by being broken down into component parts, each of which can be taught separately, then reassembled (Light, 2008). This approach to teaching and learning tends to be used when planning practical activities; for example, techniques or processes are broken down into simple procedural stages, often taught through a series of teacher-led demonstrations. Here, the focus is for learners to concentrate on and remember key points and/or key stages, rather than considering the information as a whole (Pham, 2011). As a result, knowledge gained is often reduced and somewhat fragmented (Schunk, 1996) and often neglects the bigger issues associated with the specific learning.

Such a reductionist model of teaching and learning is based on reductionist assumptions that knowledge is made up of elementary units of experience, which are grouped, related, and generalised, and that the parts of a given learning experience are equal to the whole (McInnes, 1995). In this model, which units are to be taught and in what sequence they will be presented, is determined by the teacher. James (2008) argues reductionist teaching and learning is common in school contexts; firstly, it is an economical approach to learning and, secondly, basic facts and skills are the foundation for more sophisticate knowledge and practice. The use of examinations to measure observable behaviour of learning, the use of rewards and punishments in our school systems, and the breaking down of the instruction process into 'conditions of learning' are school-based 'reductionist' models of behaviourism (Atkisson, 2010).

A fundamental criticism of behaviourism is that it ignores the influences of mental processes on learning and cannot fully support the complexities of human learning, especially creative skills development or problem-solving skills (Sammons, 2013). Pitler, Hubbell, Kuhn and Malenoski

(2007) argue behaviourist approaches to learning can be effective in certain contexts and work well when used in combination with one or more of the other learning theories.

2.2.2 Cognitivist learning theories

Cognitivism replaced behaviourism as the dominant learning paradigm in education during the 1960s. Cognitive psychology proposes that learning comes from mental activity such as memory, motivation, thinking and reflection, and considers learning as an internal process that depends on the learner's capacity, motivation and determination (McLeod, 2009). Cognitivists describe learning as a process of altering a learner's mental model, whilst learning may result in a change of behaviour; cognitivists believe it is primarily a change in understanding (Atkisson, 2010).

The cognitivists (e.g. Piaget, Bruner, Vygotsky, Gagne) consider that the learning process is the *adoptive* learning of techniques, procedures, organisation and structure to develop internal cognitive structures that strengthen synapses in the brain (Craik and Lockhart, 1972; Craik and Tulving, 1975). The learner receives the learning, accepts it, stores it, relates it to existing ideas and information, indexes it and then retrieves it, so that they can find it in their memories later when they need it (Ausubel, 1974). Thus, learning is seen as the process of connecting pieces of knowledge in meaningful and memorable ways. In this regard, cognitivism focuses on the transmission of information from someone who knows (such as an 'expert' as opposed to facilitators) to learner novices (Xu, 2012).

Jean Piaget's (1896-1980) theory of cognition is based upon three basic components: schemas (building blocks of knowledge); assimilation and accommodation (processes that enable the transition from one stage to another); and four stages of development. Piaget believed cognitive development involved a progressive reorganisation of mental processes as a result of biological maturation and environmental experience and described assimilation as a cognitive process of fitting new information into existing cognitive schemas, perceptions, understanding and accommodation as adjusting information already acquired to incorporate new information. Piaget argued the process of learning is achieved by creating disequilibrium or an imbalance, between what is understood and what is encountered. Learners naturally try to reduce such imbalances by using the stimuli that cause the disequilibrium and developing new schemes or adapting old ones until equilibrium is restored. This process of restoring balance is called equilibration and learning depends on this process. Teachers should maintain a proper balance between actively guiding the child and allowing opportunities for students to learn through exploration and self-discovery. This equilibrium needs to be clearly evident in the planning process and the learning activities chosen by the teacher.

Whilst 'assimilative' theory of learning has developed from a body of psychological literature related to theories of cognition, it also draws several parallels to behaviourist paradigms. Illeris describes 'assimilative theory' as learning associated with school-based subjects (Illeris, 2009: 13) and suggests that 'assimilative' learning is based upon 'learning by addition'; that is, learning that is generally built up by means of constant additions to what has already been learnt. Here, Illeris focuses upon the 'progressive' nature of learning in schools, dominated by an increased complexity of knowledge, skills and understanding in relation to maturity. A progressive framework for assessing learning is evidenced in the 2007 attainment targets, with each attainment level or target involving the acquisition of more complex knowledge and skills (DCSF/QCA, 2007: 58-59) (see Appendix B). An 'assimilative' theory involves a process of 'assembling', whereas a behaviourist approach involves 'disassembling then reassembling' complex learning, a subtle difference for both the teacher and learner. However, this distinction may be revealed through the teaching opportunities and strategies used by Design and Technology teachers evident in their planning process.

Illeris (2009) argues that, through 'assimilative' learning, knowledge oriented towards application to a certain subject (or scheme) is developed, which can be used in situations that bring the subject in question to the fore; consequently, the *associative* nature of ‘assimilative’ learning provides easy prompts and easy recall for learners. Thus, ‘assimilative’ learning results in close links and connections being formed between the new learning and the schema or pattern in question. Therefore, when applying new learning, students are ‘mentally oriented’ towards the field in question (Illeris, 2009: 13), similar to a ‘mental mind map’ approach to learning. This is particularly relevant to this research study as it potentially provides a pedagogical method of producing learning outcomes quickly and easily. Learning gathered via worksheets, where key questions or ‘clues’ are provided by the teacher to signpost the learner to the correct or required solution, are examples of the *associative* nature of ‘assimilative’ learning and bring both reliability and validity into question in regard to learning outcomes demonstrating learning.

‘Accommodative’ or ‘transcendent’ learning is characterised by the breakdown of parts of an existing scheme and reconstruction in such a way that it allows the new situation or information to be linked into existing schemes (Illeris (2003). Clearly in accordance with Piaget’s accommodation theory, ‘accommodative’ learning is experienced when something takes place that is difficult to immediately relate to any existing scheme and is experienced as something deeply internalised (Illeris, 2003). Whilst the current situation in schools tends to focus on disassembling learning into *chunks*, teaching the disassembled learning and then reassembling it, the ‘accommodative’ learning focuses upon the learning process inherent in the process of reassembly.

The role of the cognitivist teacher is to assist the learner's application of the proper learning strategies (Gordon, 2009) in order to develop prior knowledge and integrate new knowledge. Cognitive approaches to teaching align to Piaget’s theory of cognition and require careful assessment of the current stage of a child's cognitive development, with learning tasks and activities tailored to their specific developmental level. This involves a differentiated lesson planning process, with the adoption of differentiated learning statements, learning opportunities and/or learning outcomes being considered. Teachers adopting a cognitivist approach are concerned with the processes of learning rather than the end product (McCleod, 2011), providing students with learning opportunities that enable them to advance through each developmental stage. Aspects of the 2007 National Curriculum align to this approach to teaching and learning. Because learning is largely considered self-motivated in the cognitivist framework, cognitivists such as Brown and Ferrara (1983) have suggested methods which require students to monitor their own learning, for instance the use of learning journals by students to monitor their learning progress and highlight any recurring difficulties, thus requiring a more reflective attitude to learning progress.

A frequent misperception with reference to cognitivism involves issues with *decontextualising* the learning (Anderson, Reder and Simon, 2000). Decontextualisation of 'formal' learning experiences, or learning that is isolated from the contexts in which it derives meaning (Choi and Hannafin, 1995), in a cognitive framework, results from the primary focus being placed on the processes of 'rebuilding' the requisite learning or task (Anderson et al., 2000); that is, the processes of learning. The misunderstanding stems from consideration of the learning process and not the context or situation it can be referenced to. However, as Anderson et al. (2000: para. 10) argue, 'assessing learning and improving learning methods requires research and instruction in contexts that are consistent with the scopes of the skills currently under investigation'. 'Situated cognition' suggests learning is 'naturally tied to authentic activity, context, and culture' (Brown, Collins and Duguid, 1989) and provides many similarities to 'situated learning'.

'Situated learning' introduced by Lave and Wenger (1991) challenges the traditional approaches of education and psychology by focusing on social relationships and situations of co-participation rather than the acquisition of certain forms of knowledge. Advocates of 'situated learning' ask what kind of social engagements provide the proper context for learning to take place (Hanks, 1991).

Instead of regarding learning and cognition as universal processes and studying learning as decontextualised, but by viewing learning as situated and bound to specific settings, learning outcomes in whatever way we choose to define them, cannot be separated from the learning experiences that produced them, such as the nature of the learning environment (Andersson and Andersson, 2005). In the last thirty years a sociocultural orientation to learning has become increasingly prominent and has focused upon the classroom setting and how it might promote learning (Saljo, 2000; Cowie, Moreland and Otrel-Cass, 2013). A sociocultural perspective on learning revolves around issues of participation and identity (Wenger, 1998), with learning considered to be the property of the community or social group. A sociocultural approach requires tasks to be collaborative, with students being involved both in identifying the task and developing a solution, thus providing a clear alignment to the requirements of Design and Technology teaching and learning. Learning outcomes are considered to be 'true' engagement in 'ways that others in the community of practice find beneficial' (James, 2008: 30).

2.2.3 Constructivist learning theory

Constructivism as a paradigm posits that learning is an active, constructive process and has emerged as a powerful model for explaining how knowledge is produced in the world, as well as how students learn (Gordon, 2009). The constructivist paradigm presents a model of learning in which individuals construct a mental representation of the world, and in which their existing mental schemata are tested and adapted through experience and through interaction with other people (von Glaserfeld, 1995).

Constructivist learning theory is based on the principle that learning is an ever-changing process in which learners create, interpret and reorganise knowledge in ways that are individual to the learner (Novak, 1993). Constructivist views propose that knowledge develops in such a way that learners organise and manage experiences so that their actions maximise desirable results and minimise undesirable ones (Watts and Jofill, 1998). Learning requires not simply absorbing information, but actively processing it, through a process of 'meaning-making', with emphasis on the development of conceptual understanding (Watkins, 2011). Based upon a constructivist paradigm, Watkins (2011) introduces a view of learning identified as *individual sense-makers*, focusing attention on the learner and their cognitive, emotional and social processes. This learning theory is clearly aligned to Illeris' view, that all learning includes three dimensions, namely 'the cognitive dimension of knowledge and skills, the emotional dimension of feelings and motivation, and the social dimension of communication and co-operation, all of which are embedded in a societally situated context' (Illeris, 2003: 396).

Von Glaserfield (1995) argues that, at the core of constructivism in the classroom, are issues of authority, ownership and power. As discussed above (p. 24), constructivists view learning as a very personal, subjective experience/process. In contrast, teaching is a very public activity. Formal teaching, therefore, can be seen as a purposeful, designed intervention into the process of learning. Such an intervention affects the balance of ownership over the learning (von Glaserfield, 1991) and often removes authority from the learner. This situation is exacerbated by the current objective or outcome-led education system, where the teacher is not only required to specify the learning, but also the strategy for providing the opportunity to acquire the learning, the method of capturing and gathering the learning and the nature of the learning (Swaffield, 2009); thus, leaving little or no room for student 'ownership of their learning'. In relation to the teacher-student relationship (Bell and Dale, 1999), constructivism can theoretically be considered as 'mixed authority' teaching (Watts and Jofill, 1998), where both the teacher and student has control of the learning at various and appropriate points in the learning journey. As the *Teaching and Learning in 2020 Review Group* reports, high quality teaching requires a strong, collaborative relationship between learning and teaching, 'enabling teachers and students to move learning forward together' (DfES, 2006a: 13). 'Mixed authority' teaching is difficult for many teachers to countenance, with many teachers insecure about changing any significant part of their classroom practice towards a constructivist perspective because of the fear of losing classroom control (Watts and Jofili, 1998). Such a 'mixed' approach to learning is conducive to quality Design and Technology; for example, the use of open-ended tasks based on areas of inquiry requiring students to explore ideas, build on the ideas of others, and reflect on what they have learnt.

In contrast, Watkins' *individual sense-making* view clearly places the emphasis on the learner, recognising that it is the learner that is constructing sense from their own environment and not passively receiving it. As James argues, the idea that it is possible to achieve one to one correspondence between what is in the teacher's head and what the student learns is 'neither realistic nor ultimately desirable' (James, 2008: 22). A learning cycle of active experience, reflection, making sense and application tends to dominate Watkins' view of learning, a concept that will be explored through the learning activities evident in the lesson plans. Clearly, it could be argued that Watkins' (2011) approach to learning derives from a constructivist viewpoint, although James (2008) would argue a cognitive constructionist viewpoint is better suited, as learning and knowing is approached from the perspective of the individual (Derry, 1996).

The idea that learning should be *personal* gradually entered the educational policy debate in the UK with the start of the new millennium, and in 2001 the Government made explicit that each child should be educated in a way and at a pace that suits them, recognising that each learner is different, with different abilities, interests and needs (DfES, 2001: 20). Personalisation was the foundation for the *Five Year Strategy for Children and Learners* published by DfES in July 2004 (DfES, 2004d). By definition, constructivists view learning as personalised learning, allowing students to make sense of their experiences in unique ways (Moon, 2002). Tension arises when personalised learning is combined with learning outcomes that have already been pre-specified by the teacher. For learning to be considered personalised, the form, type and production of the learning and learning outcome has to allow a degree of student control and conflicts with the current outcome-based education approach. By exploring the *intended* and *actual* learning activities/opportunities and the *intended* and *actual* learning outcomes, the involvement of both the teacher and the student can be established.

2.2.4 Constructivist teaching strategies

Scaffolding, a concept developed by Wood, Bruner and Ross (1976: 90), involves an 'adult controlling those elements of the task that are essentially beyond the learner's capacity, thus permitting him to concentrate upon and complete only those elements that are within his range of competence'. Scaffolding and modelling teaching strategies are embedded in a constructivist approach to learning and are common teaching strategies used in secondary schools in England (Kington, Regan, Sammons and Day, 2012). Inherent in scaffolded instruction is Vygotsky's idea of the 'zone of proximal development' (Vygotsky, 1978: 86). The zone of proximal development (ZPD) has been defined as 'the distance between the *actual* developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers' (Vygotsky, 1978: 86). Sadler's (1989) common interpretation of a constructivist approach to learning emphasises the responsibility of the teacher to define the gap between what the learner can achieve without help and what may be achieved with suitable help from a teacher. Once the student, with the benefit of scaffolding, masters the task, the scaffolding can be removed and the students will then be able to complete the task again on their own, thus implying a temporary intervention. Scaffolding techniques, as *temporary supports* should be considered as important, as the teacher needs to carefully plan the time needed before the scaffold is removed and the conditions of such a removal. Cowie, Moreland and Otrel-Cass (2013) consider scaffolding to be a form of feedback that supports the gradual transfer of responsibility for learning to the student and, as such, would reinforce Watt's (1998) notion of 'mixed authority' teaching. The gradual transfer of responsibility for learning varies from student to student, thus increasing the chances that every student will get the support they need. Sadler (2007) raises a cautionary note in regard to the current outcome-led education context and the level of assistance given by teachers to students in the form of scaffolding learning, arguing that scaffolding has become so elaborate and the level of assistance so comprehensive, that the learner cannot help but succeed.

2.2.5 Issues with a constructivist approach to learning

The overuse and often misuse of the term ‘constructivism’ is evident in the educational literature, in academic papers, books used for teacher training, curriculum development and assessment. Seldom clearly defined, the level of precision in relation to terminology relating to constructivism is often low (Sjoberg, 2007). Within the field of education, a variety of themes in relation to constructivism exist; for example (Soloman, 1994) cognitive constructivism (often referenced to Piaget); social constructivism (often with reference to Vygotsky); and simple or mild constructivism (with reference mainly to some interpretations of Piaget), adding to the uncertainty and confusion. A regular posit within the literature relates to the notion of ‘constructivist teaching’. Some writers (for example, Driver, Asoko, Leach, Mortimer and Scott, 1994; Duit, Goldbergy and Niedderer, 1992; Fensham, Gunstone and White, 1994) use the expression as shorthand for teachers who try to foster constructivist perspectives on learning through particular systems of classroom organisation and methods. However, Matthews (1994) and Millar (1989) argue that there are no classroom techniques which are exclusively constructivist. Other authors make the point that ‘constructivism’ is not a teaching theory, but a theory on knowledge and learning (Grennon Brooks and Grennon Brooks, 1999).

The notion of teaching and the role of the teacher in relation to a constructivist view of the learning process are particularly interesting as, fundamentally, it is impossible for teachers to ‘construct’ knowledge for learners – or, for that matter, learners to have conceptual change constructed for them (Watts, 1998). Thus, the assumption that constructivist teaching and learning is ‘student-centered’, rather than curriculum-based, is easy to make (Gordon, 2009). A ‘student-centered’ approach to learning is often attributed to a frequent misconception regarding constructivist teaching involving, as Baines and Stanley (2000) argue, the teacher setting up the learning environment, knowing student preferences, guiding student investigations and then ‘getting out of the way’ (Gordon, 2009: 739). However, a constructivist classroom is one in which there is a balance between teacher- and student- directed learning and requires teachers to also take an active role in the learning processes (Gordon, 2009). Constructivism approaches teaching as facilitating and guiding with the facilitator supporting students to construct their own knowledge.

2.2.6 A constructivist approach and Design and Technology education

The link between constructivism and Design and Technology education has been affirmed numerous times (Scheer, Noweski and Meinel, 2012; Fox-Turnbull, 2010; Fox-Turnbull and Snape, 2011; Neo, Neo, Kwok, Tan, Lai, and Zarina, 2012). Design and Technology is a holistic and practically based curriculum, ideally suited to constructivist approaches to learning (Fox-Turnbull, 2010). Furthermore, the nature of designing inherent in Design and Technology is a social activity, involving the interaction between student/student and student/teacher (Hamilton, 2004; Hennessy and Murphy, 1999; Murphy and Hennessy, 2001; Fox-Turnbull, 2010). Likewise, Compton and Jones (2004) state that technological knowledge is socially constructed.

Constructivist approaches to Design and Technology learning requires students to use their knowledge to solve problems that are meaningful and realistically complex, and provide students with opportunities to explore and reflect on, their knowledge construction (Mordechai, 2009). The problems presented as the learning focus provide the context for the student to apply their knowledge and to take ownership of their learning (Tam, 2000). In relation to Design and Technology education, Murphy and Hennessy (2001) argue that two interrelated aspects are necessary – personal and cultural authenticity. Design activities that are both personally and culturally authentic ‘provoke a genuine, rather than tokenistic response from students’ (Barlex, 2008: 51).

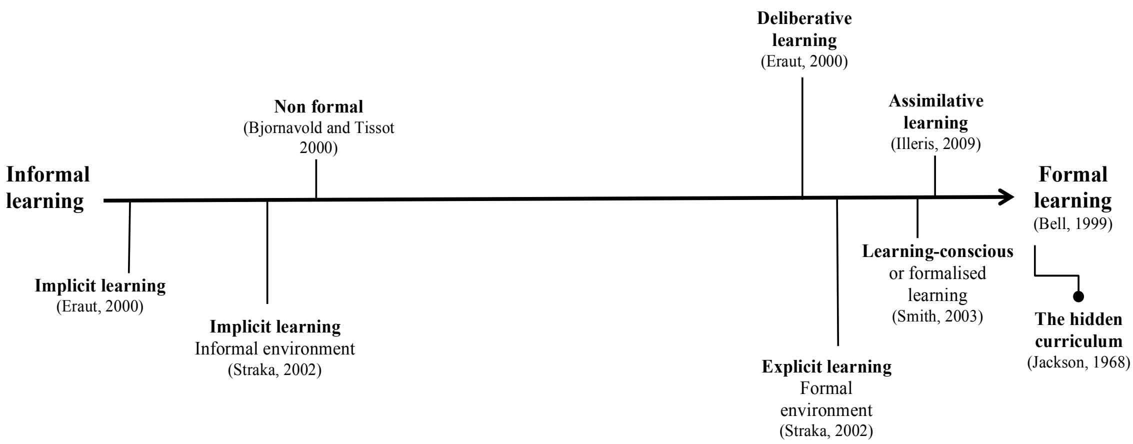
Watkins' (2003) third approach to learning is located within a socially constructed paradigm. Learners build knowledge as part of doing things with others, which involves constructing meaning together in social settings. It is based on the belief that human learning is necessarily and fundamentally social as it utilises language, culture and communication, and implicates our identities and preferred futures (Watkins, 2011); that new knowledge emerges in the process of social activity, especially in dialogue. Watkins (2003) argues the settings and situations, which provide the most potential for learning, are those in which participants are engaged in real action that has consequences not only for them, but also for their community as a whole. In terms of teaching, an environment in which people can be stimulated to think, and whilst being involved in authentic tasks beyond their current level of competence, is required for this approach to be effective (Hargreaves, 2012). Watkins' third approach to learning is synonymous with social constructivism.

Having provided a 'landscape' for learning in relation to learning paradigms, *classroom-based learning* will be located within that landscape and learning will be examined from a pedagogical perspective, thus providing a clear picture of the influences and emphasis on learning in the classroom.

2.3 The 'continuum of learning'

Whilst current literature presents several dichotomies in relation to learning theories; (Illeris, 2007), implicit or explicit learning, conscious or unconscious learning, 'formal' or 'informal' learning, in reality learning is not a static entity. As Winch (1998) argues, there are many and diverse cases of learning, each subject to constraints in a variety of contexts. It is, therefore, useful and more appropriate to consider learning as a continuum (Eraut, 2000). Although this research project is focused solely upon 'formal' learning, it is important that this does not limit understanding of learning. In order to better understand the relationship between several alternative approaches to learning, and to highlight the forms of learning that can both demonstrate learning in a classroom and produce the physical evidence of learning required in the current education model, Figure 2.2 represents several current theories on how we learn.

Figure 2.2 The 'continuum of learning' from 'informal' to 'formal learning'



The common separation between informality and formality of learning is emphasised in much of the literature concerning learning and education (Eraut, 2000; Hodkinson, 2005; Pring, 2000; Hewitt, 2008). Formal forms of learning are described as planned, teacher-dominated and assessed, and take place in educational institutions, whereas 'informal' learning tends to be unplanned, incidental and unassessed and uncontrolled by a teacher, and generally takes place in everyday life (Hodkinson, 2005). 'Informal' learning is often treated as a residual category to describe any kind of learning which does not take place within, or follow from, a formally organised learning programme or event; as such, it is often considered inferior or a 'lesser' form of learning (Coffield, 2000; Weeden, Winter and Broadfoot, 2002). Non-formal learning lies somewhere between the two, as it is embedded in planned activities that are not explicitly designed as learning (Bjornavold, 2000). However, current research into these distinctions has found very little agreement about how to define the boundaries between them (Colley, Hodkinson and Malcom, 2003; Cullen, Johnson and Sakono, 2000).

Classroom-based learning involves a *consciousness* of learning, in as much as the learning is explicit; as opposed to *implicit* where the learner has no or little awareness of what is being learnt (Berry, 1997). Students are aware that the lesson they are engaged in entails learning and that learning is the goal of the activity (Smith, 2003). By making the learning explicit, it is deemed enhanced, clearly aligning to *classroom-based learning* (Rogers, 2003).

Particularly relevant to this research study is the distinction between explicit or implicit learning and formal or non-formal environmental conditions, as introduced by Straka (2002), which provides a far more practical and realistic distinction than 'formal' and 'informal' forms of learning. Eraut (2000) defines three main forms of learning: implicit learning, where learning is not undertaken in any conscious way; reactive learning, which it is seen as being spontaneous in its development; and deliberative learning, which is concerned with and involving a planned context, such as the classroom. Tough (1971) argues that deliberative learning includes both deliberate learning, where there is a definite learning goal and time is set aside for acquiring new knowledge, and engagement in deliberative activities such as planning and problem solving, for which there is a clear work-based goal with learning as a probable by-product.

Generally, the 'informal' phase of the continuum involves learning that is largely *invisible*. Such forms of learning are difficult to identify, isolate and measure and, therefore, not currently deemed valuable when demonstrating the learning progress in school (James, 2008). Eraut (2000) argues that a focus on measurable learning outcomes diverts attention from other valuable forms of learning. A typical example involves the 'hidden curriculum', considered a side effect of an education system (Martin, 1983). The 'hidden curriculum' provides learners with important skills, such as the transmission of norms, values, and beliefs through assumed rules, adult or student expectations, idioms and metaphors conveyed in the classroom and the social environment (Giroux and Penna, 1983; Cornbleth, 1990). In a classroom setting, the development of these 'hidden skills' may occur simultaneously to 'formal' learning (Kentli, 2009).

The concept of a 'hidden curriculum' is well established in education and a variety of strategies and initiatives in the UK have attempted to formulate aspects of it, for example, Personal, Learning and Thinking Skills (PLTS) (QCA, 2008b). However, QCA never addressed the key issues of progression and assessment of the PLTS and, therefore, it has been suggested that neither students nor teachers valued the initiative (Swaffield, 2009).

2.4 The concept of a learning outcome

Whilst the visible, assessable outcomes of 'formal' learning provide the focus for this research study, learning outcomes are both conceptualised and operationalised within an educational context in a variety of different ways (see James and Brown, 2005; Daugherty, Black, Ecclestone, James, and Newton, 2008; McCarthy, 2011; Sadler, 2007). This range of opinions derives from a lack of clarity around the many terms that can be used to describe the same or similar concepts, for example learning objectives, learning goals, learning intentions and learning outcomes. Although multiple definitions exist, all are similar (Adam, 2004). In much of the current literature, the terms are, in fact, often either used interchangeably (Melton, 1997). Lawson and Askell-Williams (2007) argue that learning outcomes tend to focus on capabilities, whilst learning objectives comprise a change of emphasis from capabilities to aspirations and requires an entire refocusing of our approach and attitude to education. However, in reality, such a subtle use and misuse of language is difficult to plan for and distinguish in the classroom. The lack of any agreed definition of learning outcomes in secondary schools generates both misunderstanding and misuse of learning outcomes in the classroom (Hussey and Smith, 2008).

Several definitions of learning outcomes exist that differ in focus or emphasis. The Department of Education describes learning outcomes in secondary schools as ‘setting out what a learner is expected to know, understand and be able to do as the result of a process of learning’ (DfE, 2010). Thus learning outcomes are considered a prediction of the learning, more aligned with *intended* learning statements, and implying they support the teacher’s planning processes. Adam (2004) describes learning outcomes as the products that are produced as a consequence of a learning process that tend to be concerned with the achievements of the learner rather than the intentions of the teacher, suggesting learning outcomes demonstrate learning progress and, therefore, fulfilling an ‘assessment’ function. The term ‘evidence of learning’ is clearly synonymous with this particular emphasis and is generally used in a more formulised, pre-designated way, often in the medium-planning phase, and used by the teacher to moderate and standardise learning across the cohort.

Current educational practice surrounding the concept of a learning outcome is dependent upon the rather simplistic notion that learning outcomes can demonstrate learning (Swaffield, 2009); furthermore, that learning outcomes can demonstrate the range of learning set out in the National Curriculum. A learning outcome is only the representation of learning – not the learning itself (Gosling and Moon, 2001) – and certain types of learning are easier to represent or demonstrate than others. Different types of learning, such as metacognitive skills, creativity and problem-solving skills, do not easily provide learning outcomes, consequently, such types of learning are often overlooked by teachers (Kimbell, 2003; Richardson, 2010). Learning outcomes that are both easier to produce and easier to assess, and provide evidence for learning progress, dominate school-based learning (Hargreaves, 2005) and are regarded as important by both the student and the teacher (Wiliam, 2008). The result is a limited range of types of learning produced in classrooms, producing a limited range of learning outcomes, an issue raised in several key articles (Daugherty et al., 2011; James and Brown, 2005; Wiliam, 2008).

However, learning outcomes, in whatever form they take, for example in an essay, as a physical outcome or in a verbal statement, allow teachers to make judgements on whether a student has absorbed the *intended* learning and to what degree. As highlighted throughout this chapter, learning is a complex entity and, therefore, difficult to translate into a physical form that can demonstrate the degree of learning achieved (McCarthy, 2011). Hewitt (2013) argues that judgements on the degree of learning should not be made on one form of learning outcome, but requires a combination of teacher assessments, student assessments and parental views, likening the process of learning to the concept of triangulation and research methodology. The ‘Assessing Pupil Progress’ initiative (QCA, 2008a) introduced the concept of a ‘standards file’, where evidence of learning is provided in several forms to ensure both reliability and validity.

The notion of an ‘outcome of learning’ was first introduced by Gagne in 1974 and is distinguished into three distinct categories by Hussey and Smith (2009). These categories are: short-term learning outcomes used in individual teaching events; medium-term learning outcomes, often specified for modules or short courses; and longer-term learning outcomes specified for a whole course or programme, for example a Key Stage. Hussey and Smith (2009) argue that the first distinction provides a useful aid to both teaching and learning, providing clarity for the planning process. This misuse of learning outcomes, predominately as performance indicators in relation to both teaching and learning, is a common discourse in current literature on learning outcomes (Hussey and Smith, 2003; Biggs, 1999; Entwistle, 2005).

The Teaching and Learning Research Programme (TLRP) was run by the Economic and Social Research Council (ESRC) with a prime objective to support research which lead to improvements in the achievement of learners of all ages, in all sectors and contexts of education, training and lifelong learning throughout the UK. Drawing on the expertise of the Assessment Reform Group (ARG) and building on the experience of the TLRP, the Learning Outcomes Thematic Group (LOTG) has proposed seven categories of learning outcomes: attainments; understanding; cognitive and creative; using; higher-order learning; dispositions; and membership, inclusion and self-worth (James and Brown, 2005). These seven categories of learning outcomes provide characteristics of the component, or components, a learning outcome may possess, thus providing a fuller description of the changes in a student who has achieved a particular learning outcome (Hussey and Smith, 2008) and aiding the assessment process and learning progress evidence. Kimbell (2003) discusses learning outcomes in relation to assessment purposes and argues that learning outcomes that are captured and gathered need to be tangible, shareable, comparable, and assessable in order for them to be useful to the teacher. Although these requirements are clearly necessary, they will further influence the type of learning that can be translated into learning outcomes.

In order to overcome the uncertainty and general confusion around these terms, this research study will use the phase *Intended Learning Statements* (*ILS*) as statements aimed at predicting the learning that will take place during the lesson (Jackson, Wilson and Shaw, 2003), and which are written by the teacher during the 'pre active' phase of the teaching-learning process. Learning outcome will be used throughout this research study to define the physical products or outcomes of a learning experience or activity, for example a lesson, series of lessons or homework tasks, and are designed to provide the student an opportunity to demonstrate their learning. Learning outcomes are the actual results of learning (Jackson et al., 2003) and are described as 'high quality, culminating demonstrations of significant learning in context' (Spady, 1994: 1). This research study is not directly concerned with achievement of the learner, but with the specific learning the learning outcome demonstrates. In order to accommodate multiple learning outcomes and align to the Key Stage 3 National Strategy (DfES, 2004a), which explains that each episode during a lesson should have a distinct purpose and distinct outcome (DfES, 2004b), the term *Episodic Learning Outcomes (ELOs)* will be used. *ELOs* are to be used as indication of the *actual* learning that has taken place, captured and gathered during the episodes involved in a *classroom-based learning* experience.

2.4.1 A learning outcome - ‘process’ or ‘product’

Although there is no external, reified entity that is ‘learning’, people construct and may regard certain processes/products/activities as such (Saljö, 2000). Illeris (2007) suggests that there are three different meanings of the term ‘learning’ in everyday speech. Learning can refer to the outcomes of learning, i.e. what has been learnt, the mental processes used by individuals while learning, or the interactions between individuals and their environment, suggesting that learning can either be viewed as a ‘product’, a ‘process’ or a ‘social activity’ (Illeris, 2007: 3). Focusing on learning outcomes calls into question assumptions about the nature of learning, and whether it is essentially a process or a product (Sadler, 2007). Described by Hodkinson as a ‘troubling dualism’, the distinction between ‘product or/and process’ is not a particularly complex one, but does have far-reaching effects on pedagogical approaches as well as curriculum design (Hodkinson, 2005: 107). Current literature on *classroom-based learning* often fails to distinguish between learning as a product or a process, or applies a ‘dual focus’ (Hodkinson, 2005: 113). Lachman (1997) contends that, in order to clarify the difference between *product* and *process,* there is a distinct need for an improved definition of learning. However, Hodkinson (2005) argues that, not only are the process and product dialectically related, but also are completely integrated. ‘That is, the process is the product and the product is the process’ (Hodkinson, 2005: 112).

Hodkinson’s ‘dual focus’ (2005) concern is exemplified further when products of learning are not confined to the end of the learning process, but can be identified, isolated and measured throughout the learning process itself. Design and Technology *classroom-based learning* is ‘process-led’ (Nicholls, 2004) and clearly exemplifies this point. Underpinning Design and Technology education is the notion of a ‘design process’ (Kimbell, 1997). Whilst Design and Technology teachers tend to adopt a prescriptive approach and guide the students through the design process, the process is fundamentally cognitive, relying on the designer thinking through the issues, problem solving and reflecting. However, by making ‘an abstract process explicit’, the teacher creates ‘an unnatural perception of order and stages in the process’ (Morley, 2002a: 15). As a result, each stage in the design process has become, in itself, a product, and the design process becomes a series of prescribed products (Kimbell, 1997). Such a situation could substantiate Hodkinson’s (2005) ‘integration of process and product’ idea; however, the relationships between the different stages in the process are often either ignored or confused. Learning outcomes regarded as the *acquisition of commodities* are relatively easy to plan, identify, capture and gather (Morley, 2002b). Learning considered as a ‘continually developing capacity’ (Swaffield, 2009: 5) involving cognitive and affective development is typically harder to identify, capture and gather and often requires more attention to issues of validity (Sadler, 2007). Arguably, teachers have devised ‘systematic ways of approaching problems in order to make “tangible” inherently abstract processes for the benefit of both themselves and their students’ (Morley, 2002b: 13).

Having reviewed the notion of learning in the form of learning outcomes approaches to education that operationalise learning outcomes will be discussed in order to investigate the theory involved in translating the concept into *classroom-based learning*.

2.5 An outcome approach to education

The concept of learning outcomes has become increasingly more dominant in education in the last twenty years (Hargreaves, 2005). Originally introduced by William Spady in 1994, an education based around goals or outcomes, that is, an Outcome-Based Education (OBE) has been adopted as the predominant education programme in several countries around the world. Malaysia implemented OBE in all of their public schools systems in 2008 (Mohayidin, 2008), Australia and South Africa adopted OBE policies in the early 1990s, but the system has since been phased out (Donnelly, 2007), and in 1994 the United States adapted an OBE system (Austin, 2000). In Europe there has been an education shift to focus on outcomes. The findings from this research study are relevant to any country that have either adopted or adapted their education policies inline with an OBE approach.

In England, a so-called 'OBE-influenced' system has been progressively adopted over the last ten years (Henson, 2008), evident through the implementation of the National Literacy and Numeracy Strategy (DfES, 2006b), the Assessment for Learning Strategy (DSCF, 2008), and national standards, frameworks and benchmarks associated with the 2007 National Curriculum. Certainly in the UK, current discourse around education practice and the national curriculum focuses firmly upon an outcome- or objective-based education system (Harden, 2002; Hargreaves, 2005; Wyse, 2003: Lambert, 2007). Current literature provides no one agreed version of OBE, with suggestions of several outcome-based influenced model of education (Henson, 2008). In such a system, the results not only govern the process, they also define the process (Harden, Crosby and Davis, 1999).

OBE places the focus upon what is important for students to be able to do as part of the learning process, then organises the curriculum, instruction, and assessment to make sure this learning ultimately happens (Spady, 1994; Davis, 2003). Whilst Swaffield (2009) argues that the main function of the teacher is to integrate subject expertise with appropriate learning activities, teachers are responsible for creating an environment that is encouraging and supportive of students engaging in the appropriate and necessary mental activity (Biggs, 2003). An OBE approach provides the focus in terms of learning for the teacher, who is left to design an appropriate learning journey. In contrast, an input-based approach to education involves emphasis on the inputs or resources the student has available for learning, such as time, access requirements, and staffing, and is often seen as traditional education (Kamii and Dominick, 1998). An outcome-based orientation involves a fundamental shift in how the education system operates, making accomplishing results more important than providing services (Spady, 1994). Illeris (2003) argues that the increasing orientation towards education and lifelong learning as important factors in the global competition has led to a growing focus on educational measures, and also to increased attention on the outcome of learning.

It is argued that the underlying theory of an outcome approach to education involves constructive alignment (Biggs, 1999), which represents a marriage between a constructivist understanding of the nature of learning, and an aligned design for outcomes-based teaching education. Based upon the notion that the learner constructs their learning through relevant learning activities designed by the teacher, appropriate to achieving the desired learning outcomes, the outcomes model is predicated on a teaching and learning system that is constructively aligned (Biggs and Tang, 2011). The teaching methods and the assessment are aligned to the learning activities designed to achieve the learning outcomes; and aligning the assessment with the learning outcomes means that students know how their achievements will be measured.

From a pedagogical perspective, OBE in itself does not specify or require any particular style of teaching or learning. However, in practice, OBE generally promotes curricula and assessment based on constructivist methods and discourages traditional education approaches based on direct instruction of facts and standard methods (Biggs, 2003). The teaching and learning principles central to OBE, namely facilitation of learning, learner-centeredness, active and participative learning, creative and critical thinking and problem solving, align to the approaches considered appropriate for effective learning in Design and Technology education (Fox-Turnbull and Snape, 2011). However, constructive alignment can be described through behaviourist principles by focusing upon the use of learning outcomes and a 'constructively aligned' assessment criterion, where learning is pre-determined (McCarthy, 2011).

An investigation into the relationship between curriculum and assessment and 'constructive alignment' undertaken by the TLRP (Daugherty, Black, Ecclestone, James and Newton, 2008) found that terms such as congruent and alignment did not fully represent the complex process of knowledge construction, or individual learning involved in current education systems. Rather, the relationships between curriculum, pedagogy and assessment are better understood as a 'complex, non-linear, interacting system with the ultimate goal being a synergy that embraces curriculum, pedagogy and assessment' (Daugherty et al., 2008: 253).

However, placing attention on learning outcomes involves placing the focus at the end of the teaching-learning process (Waters, 2013a) and, as such, learning is approached as an end *product*. This has several implications when discussing the teaching-learning process. Firstly, an intensified focus on the learning outcomes results in the learning process being distorted, with both teachers' and students' efforts focused centrally on the end product. The method of producing the *end product* becomes less important, denigrating the learning process further and serving to warp the student's understanding of what it means to learn (Sadler, 2007), thus reinforcing the student's understanding that pre-specified and predictable learning outcomes are the goal of the learning activity (Hodkinson, 2005). Hewitt (2008) argues that lesson planning documents focus almost entirely on generating learning outcomes at the expense of either the learning itself or the learning process. If Hewitt's statement is correct, assessment should dominate both the 'design' of the pro forma and the content, as learning outcomes are generated predominately for assessment purposes.

2.6 The pedagogical framework for *classroom-based learning*

The curriculum in England provides the pedagogical framework for *classroom-based* teaching and learning (Watts, 1998). The degree of teacher or student ownership of the planning, revealing, demonstrating, capturing and assessment of learning is directly influenced by revisions to, or the introduction of, a new curriculum (Prevedel, 2013). However, Hodkinson (2005) argues that it is a combination of Government policies and dominant cultural beliefs about teaching and learning that form teachers' views on pedagogy.

The 2007 National Curriculum is divided into key concepts, key processes, range and content, and curriculum opportunities (see Appendices C and D). Across all subjects areas, the key concepts were a new introduction into the National Curriculum in England and relate to the underlying principles that define a subject or domain of knowledge and were intended to form the foundation for programmes of learning, units of work and learning outcomes. The introduction of key processes for all subjects provided the essential skills and processes that students need to learn in order to progress (see Appendix D). Fundamentally, the key processes for Design and Technology represented the school-based design process (McGimpsey, 2012), from 'responding creatively to briefs', through to 'reflecting critically when evaluating' (DCSF/QCA, 2007: 53). Prior to the introduction of the 2007 National Curriculum, a common element identified in the literature is the emergence of 'the design process' paradigm, the adherence of teachers to the linear concept of the design process (Mawson, 2003). In spite of increasing rejection among researchers of the validity of this model (Assessment of Performance Unit 1991; Johnsey, 1998; Roberts and Norman, 1999), the key processes emphasised the importance of the design process to Design and Technology education and, consequently, promoted its practice.

The 2007 Programmes of Study attempted to provide a framework for assessing Design and Technology based upon the inter-relationship between knowledge, skills, understanding and process (Moreland, Jones and Barlex, 2008). Providing both key concepts, that is the knowledge and understanding, and key processes allowed teachers to at least recognise, if not fully realise, the relationship between content and process for the first time in England. The 2007 attainment targets loosely aligned to the key processes and design process (see Appendices B and D and Figure 3.1).

The 2007 National Curriculum currently in schools provided a distinct ideological and pedagogical contrast to the revised curriculum that will come into effect from September 2014. Through direct comparison of the 2007 and 2014 curriculum frameworks for Design and Technology, the effects of different approaches on learning can be highlighted and the consequential constraints and influences, such as assessment procedures on *classroom-based learning*, emphasised.

2.7 The current education context in England

In response to the over-prescribed, formulaic, standardised pedagogical approach promoted by the 2007 National Curriculum in January 2011, the Coalition Government launched a review of the National Curriculum with the intended aim of, amongst other things, giving teachers greater *freedom* over how to teach (DfE, 2012). *The Remit for the Review of the National Curriculum in England* (2012) states that its aim was to achieve a ‘new approach’ to the curriculum (DfE, 2012), one which would transform education by reducing ‘prescription and to re-establishing teaching and learning as matters of professional expertise’ [par 9]. In support of this approach, Truss (2013) has argued that a significant cultural shift is required.

It was intended that teachers make decisions on how they implement the National Curriculum, including planning for and assessment of learning, providing teachers with the ‘space to create lessons which engage their pupils’, and children ‘the time to develop their ability to understand, retain and apply what they have learnt’ (DfE, 2012: par. 9). This ‘space’ and ‘time’ was to be achieved through a significantly reduced content, setting out only the essential knowledge that all children should acquire (DfE, 2012). Richards (2013) argues that, although reviews are limited at this stage, the teaching community largely welcomes *the light-touch nature* of the current secondary proposals.

The contrast in curriculum approaches is clearly exemplified in relation to the assessment procedures currently ‘dominating’ classroom teaching and learning (Hargreaves, 2005). As part of the reforms to the National Curriculum, the current system of ‘levelling’ learning outcomes will be removed and will not be replaced (DfE, 2013e). The Department for Education argues that the 2007 system is complicated and difficult to understand for parents, encourages teachers to focus on the student’s current level and not broadly on what the learner can do, and does not fit with the new *curriculum freedoms* (DfE, 2013b). The 2014 framework will expect schools to introduce their own approaches to support student attainment and progression. The problem of 'retro fitting of a system' (Mitchell, 2014), where assessment processes and procedures are only considered after the design of the curriculum, creating a misalignment between curriculum, assessment and pedagogy, has been discussed by several writers (Westbrook, Durrani, Brown, Orr, Pryor, Boddy and Salvi, 2013; James and Brown, 2005; Wiliam, 2006). Research undertaken by the TLRP into the alignment of curriculum and assessment argued, in regard to the construction of learning outcomes the system involves a complex, non-linear, dynamic interaction between assessment and curriculum (Daugherty et al., 2008). As such, assessment practices can be developed after the design of the curriculum, as long as they 'embrace' the philosophical foundations of the curriculum.

2.8 The theoretical position adopted by this research study

In relation to learning, and in particular learning associated with Design and Technology education, the researcher and consequently this research study, theoretically aligns to a constructivist paradigm. As discussed in section 2.2.3 (p. 21) above, constructivism advocates that reality is constructed by individuals and is fundamentally subjective and subsequently each person has a different interpretation and construction on knowledge process, based on past experiences and cultural factors. Thus reality is not predictable and depends on the human interaction with the situation, which results in human perception or the *image* of reality. Constructivist posit that reality is multiple and relative.

The process of personal 'meaning making' in relationship to learning is fundamental to Design and Technology learning. A process of planning, doing, testing, reflecting, modifying and concluding is embedded in any design process. The researcher, as a Design and Technology teacher, believes learning occurs when learners are actively engaged in a design process, solving practical-based problems that are challenging, have no predetermined solution and are authentic, both personally and culturally. In her opinion, students need to be able to explore possible solutions, using knowledge acquisition, personal experience, reflection and collaborative inquiry, engaging in the process of development. Design and Technology learning opportunities need to involve a design and development approach where testing and prototyping generate further ideas, through an iterative process of modification (see section 3.8.2, p. 71 for further details on this approach to Design and Technology). Thus the design process is fundamentally personal, a product/process that is both individual to the context and to the designer.

From this constructivist viewpoint, the research methodology aligns to an interpretivist paradigm. Proponents of interpretivism share the goal of understanding the complex world of lived experience from the point of view of those who live it and recognise the impact on the research of their own background and experiences. The interpretivist/constructivist researcher tends to rely upon the 'participants' views of the situation being studied' (Creswell, 2003: 8) and recognises the impact on the research of their own background and experiences. This research study is based on the concepts that, people construct their own meaning; meaning arises out of social situations and is handled through interpretive situations; context is important thus the natural setting is used to observe and collect data; the researcher is key, as it is through their eyes that the data is collected; and, a holistic description of the event is necessary.

If constructivists believe that knowledge emerges through individuals' interaction with the environment in the course of experience, social constructivists share the view of interpretivism that meaning is created and negotiated by human actors. Social constructivism emphasises the collaborative nature of learning and the importance of cultural and social context. All cognitive functions are believed to originate in, and are explained as products of social interactions, thus learning is more than the assimilation of new knowledge by learners; it is the process by which learners are integrated into a knowledge community. The world and the things in it are seen to be not only social constructions, but also 'crucial participants' in the 'meaning making' process (Crotty, 1998: 42-65). However, social constructivism is often deemed as distinctive from interpretivism, in relation to the emphasis upon language and interaction as mediators of meaning.

The fundamental purpose of design is to change reality for people wherever the situation, thus improving the world we live in (Berger, 2009). Design and Technology is aligned to social constructivism. However Key Stage 3 students are considered to be ‘novice designers’ (Barlex, 2007), and arguably at this stage in their education, require a more *personal* awareness and involvement of the processes required for Design and Technology learning, gaining increased ownership of the action and responsibility for their learning by making design decisions related to the particular context.

2.9 Summary of Chapter Two

Planning for, including formulating, teaching, identifying and assessing, learning that takes place in a classroom setting presents a difficult topic to research, primarily due to the complex systems that are involved in the teaching-learning process. Various requirements and parameters help identify *classroom-based learning*, although there is no clear definition to support teachers’ practices. Considering learning as a continuum from ‘formal’ through to ‘informal’ types of learning provides a more realistic approach to planning for learning, allowing teachers to identify, and plan for, a variety of learning types during a lesson. Three isolated, but inter-related, events associated with *classroom-based learning* exist within the teaching-learning process, namely the learning intention, the teaching and learning journey, and the learning outcome. These will form the focus of this research study.

The three main learning paradigms, although *conservative* in their presentation, provide differing and often conflicting views of, and approaches to, *classroom-based learning* and will provide ‘clues’ as to how teachers approach the planning process. Aspects of the 2007 National Curriculum clearly align to these learning theories, with the use of learning outcomes supporting behaviourist approaches to learning, and the PLTS being based upon cognitive ideologies.

Tensions arise when there is conflict between the pedagogical framework set out in the National Curriculum and the inherent requirements of a subject. Design and Technology relies on constructivist foundations, with students generating knowledge and meaning from an interaction between experiences and ideas. The 2007 National Curriculum approach to teaching and learning requires an outcome-based structure, with a clear focus on producing measurable learning outcomes. It would seem that teachers misunderstand learning outcomes both operationally and conceptually, and that a linear, prescriptive outcomes-led approach, promoted in the National Strategy materials, is dominating current teaching practices in relation to planning for *classroom-based learning.*

Chapter Two provided a review of the 'learning landscape' by discussing several theories of learning and approaches to, and influences on, learning in the classroom. Chapter Three will locate the English Curriculum approach to Design and Technology teaching and learning within that landscape and so provide a clear 'frame' with which I will investigate *intended* learning and *actual* learning within a teaching-learning process.

Chapter Three: Teaching and Learning in Design and Technology

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This chapter focuses on the key concepts integral to Design and Technology education and resultant pedagogical implications. It analyses the teaching and learning methods and strategies associated with, and inherent in the subject, investigating how teachers interpret the curriculum requirements and translate them into a classroom environment. With reference to theories highlighted in Chapter two, this chapter will provide further consideration of the conceptualisation and operationalisation of learning intentions and learning outcomes with specific reference to Design and Technology.

Although several writers, over many years, have attempted to model and describe the teaching-learning process (Carroll, 1963; Proctor, 1984; Cruickshank, 1985; Gage and Berliner, 1992; McIlrath and Huitt, 1995; Garrison and Archer, 2000), it is not within the scope of this research study to review models of teaching and learning. However, the term 'teaching-learning process' is used throughout this research study to emphasis the iterative and interrelated relationship that is required between teacher and learner within a classroom environment.

3.1 *Classroom-based* Design and Technology learning

Learning in school is dominated by the acquisition of knowledge and skills (Eraut, 2000; Pring, 2000; Illeris, 2003; James, 2008; Swaffield, 2009). Knowledge, often associated with attainment in secondary schools, relates to the concepts, facts, processes, language, narratives and conventions distinctly connected to a subject (James, Pollard, Rees and Taylor, 2005). Skills are related to 'using'; that is, how to practice, to manipulate, to behave, to engage in a process or systems (Sfard, 1998). Knowledge and skills have traditionally been the mainstays of the English education system (Perkins, 1993) and, as Taylor and Bassett (2011) argue, *classroom-based learning* equals knowledge and skills.

In order to make progress at school, students are expected to deepen and broaden their knowledge and skill base. Learning progress requires the teacher to produce evidence of learning or learning outcomes that demonstrate or prove student learning. One of the key virtues of focusing on knowledge and skills is the relationship to learning outcomes (James, 2005), as progression in both knowledge and skills can be easily planned and then identified by the teacher. Learning that involves developing knowledge and/or skills provides 'easily measurable' learning outcomes in the form of either written texts in relation to knowing, or performances in relation to acquiring skills (Moreland and Jones, 2000). Consequently, knowledge and skills tend to dominate OBE systems. However, the development of knowledge and/or skills does not guarantee learning (DuFour, DuFour, Eaker and Karhanek, 2004) and does not align to Eraut's (2000) definition of 'formal' learning (p. 13), which requires knowledge to be used in new contexts. Students can acquire root-learnt knowledge and routine skills without understanding the basis or when to use the knowledge and/or skill.

A national curriculum is supposed to comprise a body of knowledge, skills and understanding that a society wishes to pass on to its children and young people (CSF Committee Report, 2009). The balance between specifying the content in detail but not over-prescribing, and the use of general terms that do not require teacher interpretation, is a persistent concern with relation to *intended* and *actual* learning. In this regard, Wilson and Black (2007) draw attention to the paradox that a more tightly prescribed curriculum is often more helpful to learners and teachers, providing a clear framework to plan teaching, learning and assessment activities. A tightly specified Programme of Study reduces the need for teacher interpretation, lessening the risk of misinterpretation or misunderstandings. Daugherty et al. (2008: 249) contend 'the synergy' between the assessment and effective pedagogy is consequently improved.

As well as being required 'to know' and 'to be able to', the requirement 'to understand' has developed as an important aspect of *classroom-based learning* and is often described as the application of knowledge and skills (CUREE, 2012). 'Understanding' is an abstract concept that is challenging to define and difficult to study from a scientific perspective (Bransford, Brown and Cocking, 2000) and, as Heick (2012: par. 18) contends, 'understanding is borderline indescribable and also often impermanent'. Thus, it is difficult to plan for, teach, and, most noticeably, identify and assess. Bransford, Browning and Cocking (2002) argue that, although understanding is considered a necessary element of curricula, the focus on content and the memorisation of content knowledge is often over-emphasised in modern curricula, presumably due to the challenges related to developing 'understanding'.

Nickerson (1985: 217) described understanding as an 'active process' that requires connecting facts or relating new information to what is already known into an integral and cohesive whole, such that understanding is seen to require having knowledge and then doing something with it. Often used with reference to 'ability', 'competency', 'performance' or 'capability', the *active* use of knowledge and skills is particularly relevant when discussing Design and Technology learning due to the practical aspect and cognitive processes inherent in the subject (Brown, Bransford, Ferrara and Campione, 1983). This active use of knowledge and skills equips students with the relevance needed for *deep* learning (Marton and Saljo, 1976; Biggs, 1987, 1999, Entwistle, 2005). A *deep* approach to learning involves students aiming towards understanding, as opposed to a *surface* approach, where students are simply aiming to reproduce material in a test or exam (Case, 2008).

Pertinent to *classroom-based* learning and particularly learning outcomes, Blythe and Perkins (1998: 12) developed a definition of understanding from a performance perspective, explaining that 'understanding' is a matter of 'being able to do a variety of thought-provoking things with a topic, such as explaining, finding evidence in examples, generalising, applying, making analogies, and representing the topic in new ways'. The advantage of performance is that the learning outcomes are generally visible (Kimbell, 2003). Whilst understanding demonstrated through performances may support the production of accessible learning outcomes, restricting the form through which learning relating to understanding is demonstrated limits the planning processes and ultimately restricts the teaching-learning process.

3.2 The development of Design and Technology in England

The Design and Technology National Curriculum Programmes of Study for Key Stage 3 sets out the knowledge, skills and understanding needed to progress learning in the subject. The nature of the subject, including the various material-focus areas, the designing and making aspects, and contextual requirements ensures a multidimensional subject with a breath of skills, knowledge and understanding that are hard to specify in terms of a distinct content (Moreland, 2008). The form and focus of the Programmes of Study have evolved since the inclusion of Design and Technology in the National Curriculum and will be briefly reviewed here in order to provide a greater comprehension of the current Programmes of Study, as well as highlight the changes in emphasis in relation to what learning is in relation to Design and Technology.

In 1988, the Parkes Report produced by the Design and Technology Working Group, envisaged a subject where learners had a 'balanced experience of the use of different resources of knowledge and skills' (DES/WO, 1988: 8). The first National Curriculum Statutory Order for Design and Technology (DES, 1990) included four broad groupings: developing and using artefacts and environments; working with materials; developing and communicating ideas; and satisfying needs and addressing opportunities.

This early model of Design and Technology had a greater emphasis on conceptual knowledge and was aimed at providing the knowledge and skills required to develop Design and Technology capability. The place of knowledge in Design and Technology appeared to be well considered and clear, and the relationship between knowledge and skills well defined (NCC, 1991). The application of knowledge and skills would be assessed in terms of a student's capability, thus the attainment levels, which identify the 'knowledge, skills and understanding which pupils of different abilities and maturities are expected to have by the end of each key stage' were capability-based (Kimbell, 1997).

In 1995, the National Curriculum for Design and Technology stated that:

> Pupils should be taught to develop their design and technology capability through combining their Designing and Making skills with knowledge and understanding in order to design and make products. (DfEE, 1995: 6)

The 1995 revision of the Key Stage 3 Design and Technology Programmes of Study brought about a greater clarity through more details in relation to specifying the particular content knowledge and skills required, and involved a combination of 'designing and making' skills and 'knowledge and understanding'. In particular reference to 'knowledge and understanding', it stated:

> pupils should be taught about materials and components and should consider the physical and chemical properties of materials and to relate these properties to the ways materials are worked and used. (DfEE, 1995: 7).

It was considered that, by clearly defining the knowledge and skills, teachers could plan teaching and learning opportunities more effectively, ensuring learning, teaching and assessment aligned. In addition, the attainment targets were simplified in line with the revised focus on clearly defining the knowledge and skills: Attainment target 1: Designing, and Attainment target 2: Making (DfEE, 1995). As a consequence, standards improved (Green and Steers, 2006).

The 2007 National Curriculum provided a standardised approach across all subjects, focusing upon the application of Design and Technology knowledge and understanding. Through the introduction of key concepts and key processes for all subjects in England, the processes within Design and Technology were identified alongside the knowledge and skills. A focus on the application of 'knowledge' has always been present in Design and Technology learning (McCormick, 2002), and the 'active' use of knowledge and skills is evident in the various 'thinking-centered processes' such as designing, evaluating skills and problem-solving associated with the subject. Moreland, Jones and Barlex (2008) develop this concept further, arguing that the application of knowledge, skill and understanding is where students' ability in Design and Technology is actually revealed and as such, this interplay is the point where learning needs to demonstrated, captured and gathered. Indeed, planning processes would need to concentrate on the application of knowledge, skills and understanding.

3.3 Processes inherent in Design and Technology education

The relationship between the different aspects of learning, namely knowledge, skill, understanding and process, is complex in all subjects, but no more so than in relation to Design and Technology teaching and learning. The 2007 National Curriculum placed a distinct emphasis on the process of learning associated with particular subject areas. In reference to Design and Technology, this emphasis was found in the designing and making processes.

The concept of 'process-driven task-centered learning' is driven by an associated 'process' rather than 'content' based pedagogical framework. Although the development of a proactive, process-centered view of Design and Technology has been seen in other areas of the curriculum, for example process science and process mathematics, the processes associated with Design and Technology learning not only distinguished it from other subjects (Davies, 2000), but helped define the discipline (Kimbell, Stables and Green, 1996; Wilson and Harris, 2004). The 'unique' nature of

Design and Technology, in terms of developing capability to operate effectively and creatively in the made world, is frequently conceptualised within the current literature (see Holdsworth and Conway, 1999; Middleton, 2005; Kimbell, 2006; Green and Steers, 2006; Barlex and Welch, 2007) and the process-based nature is a common justification of this 'uniqueness'.

Certainly, making explicit the processes inherent in the subject has had significant consequences on the development of the subject. With a focus on the processes involved in designing and making in relation to teaching, learning and assessment, knowledge and skills naturally became *subservient* (Kimbell, 2003). However as Bowen (1996: 19) contends, 'content-based learning is not the antithesis of cognitive-based learning'. In this regard, Holdsworth and Conway (1999) claim that, since the inception of the subject, the relationship between the subject content and the 'process' has been ill-defined. Subsequently, the 2007 Programmes of Study for Design and Technology lacked clarity on what should be taught, learnt and assessed. It seems that teachers needed more guidance on what, when and how to teach the core knowledge and skills in relation to teaching the processes of designing and making (Owen-Jackson, 2013). Thus, the relationship between the relevant knowledge, skills, understanding and processes lost clarity and the processes, particularly the design process, began to dominate the teaching and learning of Design and Technology.

3.4 Models of knowledge associated with Design and Technology

The concept of distinct 'forms of knowledge' was an idea initially developed by Hirst (1974), who contended:

> [T]he domain of human knowledge can be seen to be differentiated into a number of logically distinct 'forms', none of which is ultimately reducible in character to any of the others, either simply or in combination. (Hirst, 1974: 84)

By identifying central or key concepts and distinguishing features, Hirst argued that different 'forms of knowledge' could be classified, and contended that knowledge by its very nature can be differentiated into strict, non-arbitrary forms. 'Forms of knowledge' can be defined as distinct disciplines, such as mathematics, physical sciences, human sciences, religion and the fine arts. Rather than describing collections of information, 'forms of knowledge' are considered conceptual schemes that help use, categorise and rationalise data, providing frameworks to help understand experience. As Major (2012: para. 3) suggests, 'to acquire knowledge is precisely to become aware of our experience as structured, organised and meaningful'. Hirst goes on to suggest that certain 'distinguishing features' underpin each 'form of knowledge', stating that each form includes 'certain central concepts that are peculiar in character to the form' (Phillips, 1971: 28). Presumably, such 'central concepts', although not objective facts, provide the underlying principles of a discipline and relate, if not directly correspond to the 2007 National Curriculum key concepts and, as such, can be articulated in order to provide pedagogical guidance.

This view of knowledge implies a knowledge domain and associated central concepts unique to a subject area. Love (2013) suggests that such a knowledge domain can be defined and categorised and, by categorising inherent knowledge and skills, a list of competences could be produced. When related to Design and Technology education, the notion of distinct 'forms of knowledge' generates the question, 'what is the distinct form of subject knowledge associated with Design and Technology?' And, more importantly, 'what do the learning outcomes produced by this distinct form of subject knowledge look like?'.

In 1981, the Department for Education and Science (DES, 1981) recognised that:

> The designer does not need to know all about everything so much as to know what to find out, what form the knowledge should take, and what depth of knowledge is required for a particular purpose. (DES, 1981: 5).

The nature of Design and Technology activity requires knowledge, skills and understanding on a 'need-to-know' basis (Kimbell et al., 1991). Gershenfeld (2005) termed this type of knowledge, '*Just in Time'* learning as opposed to, '*Just in Case'* learning. Professional practice in design allows the task or brief to dictate both the most appropriate processes required and the necessary knowledge and skills needed to progress to an effective solution. Key Stage 3 *classroom-based learning* requires the teacher and the learning environment to support, through careful planning, the development of the essential knowledge, skills, understanding and processes, or key concepts, as students or novice designers (Welch, 2000) do not have a wide range of previous knowledge or skills. The task context provides guidance on the right depth and the right form of knowledge (Atkinson, 2013). With truly opened-ended context-dependent designing and making, the knowledge used is specific to that particular situation. At Key Stage 3, the teacher supports the learning by providing the teaching opportunities needed for the required activity, thus balancing the level of prescription in order to achieve learning progress. At Key Stages 4 and 5, the student is increasingly expected to identify and gather the required knowledge, skills and understanding relative to the context (Nicholl and McLellan, 2009).

Such an approach, which develops knowledge and skills on a 'need-to-know' basis, places an emphasis on teaching students a process that involves identifying how and when knowledge is required, and not on the knowledge students may one day need (Owen-Jackson and Steeg, 2007). Unlike other subject disciplines, this *'Just in Time'* learning makes the defining of any specific knowledge boundary difficult (Martin, 2011), while creating a subject that is unique both in terms of teaching and learning (Middleton, 2008; Barlex and Pitt, 2000; Kimbell, 1997). This emphasis requires a clear view of the role of knowledge in Design and Technology teaching and learning and will have implications for the planning, as well as the acquisition of knowledge, through suitable learning activities.

In 1949, Ryle argued that knowledge could be divided into ‘knowing that’ and ‘knowing how’ (Ryle, 1949). Often used to describe the categories of propositional or declarative knowledge and procedural knowledge, these forms exist in order to ‘learn about’ and ‘learn to’ outcomes in Design and Technology classrooms (Goodwin, 2013). In terms of learning outcomes, education systems typically focus on ‘knowing that’ (Edwards, 2005; Fox-Turnbull, 2012); that is, the acquisition of facts, information, descriptions, or skills. This type of content knowledge provides learning outcomes that can be planned for, taught, learnt and assessed and is, therefore, common in schools (James, 2008). Kimbell (2005) contends that Design and Technology learning is more than just ‘knowing that’ or ‘knowing how’ and is often associated with a different type of knowledge, ‘knowing why’. ‘Knowing why’ extends either the proficiency in a skill or the accumulation of knowledge (Baynes, 2010) and is fundamental to problem-solving and product development. ‘Knowing why’ forms the basis of design decisions and justifications throughout the process of Design and Technology and is a crucial aspect of Design and Technology (Kimbell, 2005). It is expected that learning outcomes based on ‘knowing why’ will be evident in Design and Technology learning outcomes.

3.5 Pedagogical approaches to Design and Technology education

The processes involved in Design and Technology activities, requisite procedural knowledge, practical skills, thinking skills and creative skills establish a complex inter-relationship between conceptual/content knowledge and procedural knowledge (Reddy, Ankiewicz, Swardt and Gross, 2003). The teacher is required to establish a balance between methods that effectively deliver content and develop skills (Owen-Jackson, 2013), allowing students to develop and use both content knowledge and procedural knowledge. To balance the policy guidelines set out in the National Curriculum with the complexities of the subject in order to deliver quality teaching and learning, creates a challenging context. Over-prescribing the teaching-learning approach is common, as McLellan and Nicholl’s (2008a) research concludes:

> …a substantial number [of students] felt they weren't being sufficiently challenged, were being asked to do meaningless work, did not have enough freedom to make choices and decisions about their work, were often told what to do and had to do the same as other people. (McLellan and Nicholl, 2008a: 9)

A prescriptive approach would be an ineffective teaching-learning approach, as Design and Technology education requires teaching methods that give learners the freedom to think, make decisions and make connections (Deluca, 1992).

The nature of Design and Technology provides some key pedagogical approaches to teaching and learning, namely designing activities, practical skills/making activities, evaluation or critical thinking skills and a 'real-world' contextual requirement. Each of these key areas will be discussed in turn within the context of the 2007 Key Stage 3 Programmes of Study in sections 3.5.1 through to 3.7.

3.5.1 The 2007 notion of 'key concepts'

The Design and Technology programme of Study provided a complex framework with the key concepts described as 'the heart of the subject' and as 'underlying what the subject is' (DCSF/QCA, 2007: 8). As such, the key concepts are similar to the domain constructs discussed by Daugherty et al. (2008) and Hirst's (1974) distinct 'forms of knowledge.' The key concepts for Design and Technology included designing and making, cultural understanding, creativity, and critical evaluation (DCSF/QCA, 2007: 52-3) (see Appendix C) reflecting a greater emphasis on the integrated nature of Design and Technology.

Quality teaching requires a clear and comprehensive understanding of the fundamental requirements of the subject being taught (Clarke, 2005). Therefore, the key concepts for every curriculum subject needed to be well defined, clear and detailed in their explanation, to ensure effective implementation in the classroom (Gipps, 1994; Daugherty et al., 2008). Teachers need to understand, accept and assimilate the key concepts into their teaching practice. Whilst this may be achievable with more established and traditional subject areas, it is argued that Design and Technology education suffers from so-called 'weak epistemological roots' (DfE, 2011a: 24). Design and Technology teachers do not have a robust view of the knowledge that underpins their subject (Barlex and Steeg, 2013). Difficulty in identifying key concepts may be due partly to the extensive place of procedural knowledge within the subject, the wide range of professional expertise common with Design and Technology teachers, or that technology has no commonly agreed upon epistemology (William and Lockley, 2012). Given this, accepting and assimilating the key concepts is always likely to be problematic for Design and Technology teachers.

A series of research entitled, *Assessment of Significant Learning Outcomes* (ASLO) funded by the TLRP identified how and by whom the constructs [or key concepts] involved are defined, interpreted and made real, in terms of curriculum, pedagogy and assessment practices, as being a key emerging theme (Daugherty et al., 2008). 'For assessment to be meaningful, the central learning purposes need to be clearly defined' (McLaren, 2002: 11). The TLRP (2009: 1) stated, 'the constructs underpinning Programmes of Study and their assessment are often inadequately articulated' and unclear domain concepts have led to misunderstandings in and misinterpretation of the subject (Wiliam, 2008).

Although the 2007 key concepts may be expressed clearly enough for constructive alignment to be feasible, this assumes the constructs of interest are already established, agreed and clearly expressed (Daugherty et al., 2008). In relation to Design and Technology, poor construct definition leads to ill-defined procedural and conceptual learning (McLaren, 2002) and further confuses the inter-relationships between the different types of knowledge required in Design and Technology.

Whilst the confusion may have led teachers to misunderstand the fundamental principles inherent in the subject, the 'significant learning outcomes' associated with the subject are equally confused (Daugherty et al., 2008). As McLaren (2007) argues, a lack of clarity or explanation can result in either the failure to acquire desirable learning outcomes or the acquisition of undesirable outcomes from learning.

Calling for, and attempts at, conceptual revision or clarification is a remarkably stable part of the discourse of Design and Technology (McGimspey, 2012). In relation to Design and Technology education, the learning purpose, or key concepts, has been explored by several authors (McLaren, 2007; Kimbell, Stables, Wheeler, Wosniak and Kelly, 1991; McCormick, 2002; de Vries, 2005). In addition, the nature of the subject, the various material-focus areas, and the 'designing' and 'making' elements, have resulted in strongly differentiated views about what the subject is and, more importantly, what desirable learning outcomes they should produce (McLaren, 2007). The 2007 National Curriculum went some way to align teachers' views on the purpose of Design and Technology by providing a statement (see Appendix A) addressing the importance of the subject (DCSF/QCA, 2007: 51). The degree of alignment between the Design and Technology Programmes of Study, the *intended* learning statements and the *intended*/*actual* learning outcomes will be the main focus of this research study and the results will enhance the debate.

Theoretically, the introduction of the 2007 key concepts approach provided an alternative pedagogical framework for teachers in terms of planning, delivery models and teaching methods (Davies, 2005; Morgan, Jones and Barlex, 2013). Rotational or 'carousel' models, where students move to new material areas and teachers once or twice a term, have dominated the organisation of the Design and Technology Key Stage 3 curriculum in England (Davies, 2005) since its inclusion in the National Curriculum in 1988 and the introduction of material-foci. Owen-Jackson and Steeg (2007: 182), meanwhile, argue that 'rotational courses are a pragmatic response to the 1990 National

Curriculum requirements in England', thus ensuring students experienced the material-focus and specialist teachers required to teach the various strands of the subject. Ofsted consistently raised concerns regarding a 'carousel' approach on the basis that provision of continuity and progression for students is difficult (Ofsted, 2008; Ofsted, 2011). For the first time, the key concepts approach to Design and Technology education required a coherent approach to teaching and learning, with a shift in emphasis away from teaching separate sub-disciplines (Morgan et al., 2013). In order to deliver a range and depth of knowledge, skills and understanding needed to cover the key concepts, Design and Technology teachers were required to plan their medium and long-term teaching and learning opportunities as a team, ensuring a coherent approach to the subject and clear progression in terms of the key concepts and processes.

3.6 Teaching and learning designing and making

An inherently creative process, 'designing' is described as '...the ability to visualise the future, to foresee what may happen, plan to anticipate it, and to represent it to ourselves as images that we project and move about inside our head' (Bronowski, 1973: 56). The process of designing associated with Design and Technology education is described by Norman (2000) as 'purposeful, problem solving thought and action' (2000: 90) and involves an integration of the process and content of Design and Technology. Whilst various researchers have debated the complexities of defining what students need to know in order to be able to design (Anning, Jenkins, Whitelaw, 1996; Morley, 2002b; Trebell, 2007; Hope, 2009; Atkinson, 2013), conducting empirical work on designing is difficult as, fundamentally, designing is a cognitive process, involving an intangible set of intellectual thinking skills which designers themselves often find difficult to analyse and make explicit (Lawson and Askell-Williams, 2007). Indeed, the largely subconscious process of designing renders possible definitions of what designing is in relation to Design and Technology difficult (Morley, 2002b), and consequently the designing aspect of the subject can be 'mediocre and formulaic' (Ofsted, 2008: 25).

Within this field of education research, the literature highlights two key concerns: the teacher's knowledge and understanding of designing; and the design process model used in schools (Atkinson, 2013). The complexity of defining what children need to know in order to be able to design and the need to identify and teach designerly behaviours in schools have been highlighted as key concerns for the subject for over twenty years (Anning, Jenkins and Whitelaw, 1996). In 2002, Ofsted reported that progress in making continues to be better than in designing, 'an intractable problem reported over many years…' (Ofsted, 2002: 4). With little or no help for teachers in this area, the teaching of designing was a 'significant area of weakness' Ofsted (2002: 3). The Key Stage 3 National Strategy for Foundations subjects, Design and Technology (DfES, 2004a) framework and training materials, provided specific support for teachers in relation to teaching designing. The comprehensive package provided numerous ideas for planning, teaching and assessing designing skills, including design strategies adopted from the design industry. McLain, Martin, Smith and Bell (2013) reviewed the materials from both a teaching and learning perspective and concluded the materials had a 'limited impact' and identified a slow rate of change from the traditional 'making-centric' view and focus of the subject. A lack of consistency in respect of the rollout of the materials and minimal opportunities for reinforcing the knowledge, skills and understanding were cited as causing such a limited impact (McLain, Martin, Smith and Bell, 2013). Limited research exists on the influence and impact of the National Strategy on the teaching of design.

'Making' or 'skilled knowledge' is acquired through engaging purposefully with materials and processes at first hand over time (Mason and Houghton, 2002: 44). Making is a key feature of Design and Technology with teachers teaching the practical skills needed for students to make (Tufnell, Cave and Neale, 1997). Developing 'skilled' knowledge often relies on demonstrations, observation and constant practice. Traditionally, the pedagogy associated with Design and Technology involved the teacher transferring their knowledge of skills and processes by instructing students through whole class demonstrations. The idea of scaffolding in Design and Technology involves the intention that the demonstration or *support* not only assists learners in accomplishing practical tasks, but also enables them to learn from the experience and is embedded in constructivist learning.

The complexity and intricacy of the skills being demonstrated determine the pedagogical choices (Petrina, 2007). The teacher needs to make decisions to support and facilitate learners as they mentally construct an understanding of the skills being demonstrated (McLain, 2013, 2014). Given this, the demonstration should be planned to involve more than how to perform the task. ‘The teacher must de-mystify the tool or process, explaining what is to be accomplished, what knowledge is applied and the roles of certain skills and senses’ (Petrina, 2007: 14). Planning for scaffolding of learning involves careful consideration of the requirements of the students. Common issues when demonstrating to the whole class include lengthy teacher inputs and low student involvement (Ofsted, 2011). Nicholl (2004: 2) raises concerns in relation to whole class demonstration being nothing more than student ‘replication of the procedural steps undertaken by the teacher’, supporting Petrina’s (2007) contention that demonstrations must involve more than how to perform the task, but should require the teacher to model what they know and the level of skills and safe practice attained. Replication of procedural steps is synonymous with *surface* learning, where the student focus is on the unrelated parts of a task and task is treated as an external imposition (Ramsden, 1988).

Surface learning is more likely to occur when learning is isolated from practice (Ramsden, 1992), and is characterised by students who focus on memorising what they might be questioned on later. Murphy and McCormack (1997, 2003) describe the current pedagogy in Design and Technology classrooms as ‘authoritarian’, with learners being ‘passive receivers of information, knowledge and skills’ (Murphy and McCormack, 2003: 45). Students are required to ‘make sense’ of the experience, reflect on it and put it into practice in order to learn effectively. As Benson contends, ‘if scaffolding is properly administered, it will act as an enabler, not as a disabler' (Benson, 1997: 126). Effective scaffolding of learning involves guiding learning, through activities in a manner that gradually increase the confidence and competence of the learners (Hennessy, 1993). As such, students would be expected to produce a range of *intended* learning outcomes demonstrating differing levels/degrees of learning.

3.6.1 Design and Technology and evaluating skills

Evaluation has a central educational role within the Design and Technology curriculum (Barlex, 2002; McLaren, 2002), with critical evaluation being one of the key concepts for the subject (see Appendix C). Evaluating skills involved in Design and Technology include analysing existing products and solutions, evaluating the needs of the users and context, and exploring the impact of ideas and design decisions, all of which are required throughout the design and make process. Owen-Jackson (2013: 283) states, 'evaluating is an activity which allows the pupil to make a judgement or decision about aspects as it develops'. The Welsh curriculum includes 'developing thinking', including reflecting skills as one of the four skills across the curriculum (DCELLS, 2008: 10). In Southern Australia, on the other hand, 'critiquing', one of their five essential learning strands, involves analysing and explaining the design decisions and thinking implicit in products, processes and systems made by themselves and others (Kierl, 2001).

Current pedagogical literature on critical thinking highlights a broad range of dispositions and abilities involved in developing this aspect of learning, with evaluation skills seen as the core ability (Pithers and Soden, 2000). Transferable over various domains, evaluation skills or critical thinking skills are deemed as an essential general ability necessary for the development of skills, knowledge and understanding in both school and workplace (Hughes and Lavery, 2008). However, in their review of critical thinking within education, Pithers and Soden (2000) contend that teachers do not teach thinking skills particularly well.

In respect to Design and Technology, the teaching of design evaluation and product evaluation is often over-simplified (Owen-Jackson, 2013). Whilst evaluation is part of the ‘design thinking’ and ‘decision-making’ inherent in an integrated approach to the subject (McLaren, 2002), it tends to be encouraged by teachers as a ‘final stage’ in the design and make process, that is the ‘evaluation stage’. There is a significant gap in the research evidence on teaching evaluation skills in relation to Design and Technology.

3.7 Authenticity and Design and Technology education

Design and Technology education has always been concerned with ‘real-life’ learning, with the notion of ‘real-world’ connectivity regarded as central to the tenet of high quality Design and Technology education (Nicholl, Flutter, Hosking and Clarkson, 2013; Snape, 2013). ‘Design and Technology capability empowers people to operate effectively, creatively and confidently in the made world’ (Layton, 1991: 3). Whilst ‘real-life’ learning and authentic learning often seem synonymous, definitions and usage of the term ‘authenticity’ vary depending on particular perspectives and contexts Kreber (2007). The notion of authenticity appears to relate directly to the growing interest within the education community in ‘constructivist’ or ‘socio-constructivist’ learning theories. Situated cognition, apprenticeship learning, problem-based learning, and exploratory learning are approaches to learning grounded in and derived from constructivist epistemology and are often synonymous with Design and Technology education (Newmann and Wehlage 1993; Petraglia, 1998; Slavkin 2004; Splitter 2008; Turnbull 2002). Situated learning or situated cognition (p. 20) encompasses thinking as part of a culturally organised activity carried out within a community of practitioners. Procedural and conceptual knowledge is an active part of this process (Bereiter, 1992).

The relationship between experience and learning, whether knowledge use or transfer, are serious challenges for education (Clayden, Desforges, Mills and Rawson, 1994). Sfard (1998) discusses learning theory through two metaphors: an acquisition metaphor and a participation metaphor.

Learning within the acquisition metaphor involves the accumulation of a body of facts or items of knowledge that are abstracted and generalised. 'The process may involve either reception or development by construction, but the focus is on 'gaining ownership' (Sfard, 1998: 5) or possession of something. It underlies not just cognitive models that see learning as transmission, but also constructivist models of learning, emphasising the development of ideas or construction of meaning. Much of Design and Technology teaching practice can be construed as acquisition of skills and knowledge already owned by the teacher and to be acquired by the pupil (Stables, 2008). The participation metaphor involves learning generated through participating within a community of more knowledgeable others to construct understanding. Participation takes place in the context of culture through social mediation. The focus within this metaphor is not on possession, but on participation in various kinds of activities characteristic of a learning area, as the learner gradually becomes a member of the subject community (Scarino and Liddicoat, 2009). Constructivist teaching requires students to use their knowledge to solve problems that are meaningful and realistically complex, and provides students with opportunities to explore and reflect on their knowledge construction. The problems provide the context for the student to apply their knowledge and potentially to take ownership of their learning (Tam, 2000). The settings and situations, which provide the most potential for learning, are those in which participants are engaged in *real action* that has consequences not only for them, but also for their community as a whole (Watkins, 2011) and, as such, require 'real-life' situations (Jonassen, Howland, Marra and Crismond, 2008).

'Authentic learning' typically focuses on real-world, complex problems and their possible solutions, and the benefits of such an approach are well documented (Darling-Hammond, 2008; Nicholl, Flutter, Hosking and Clarkson, 2013; Fox-Turnbull, 2013; Snape, 2013). Evidence suggests from the authors above that students learn and perform better at challenging tasks if they have an opportunity to engage in more 'authentic learning', while research indicates students perceived authenticity of a task essential in terms of investing enthusiasm and attention.

In this regard, Snape (2013) argues ‘authentic learning’ requires two key aspects: firstly, authentic pedagogies and instruction and, secondly, the inclusion and use of authentic tasks that reflect genuine design problems. ‘An essential pre-requisite to any assessment of *designerly activity* is that the tasks used for the assessment are as similar to professional design activity as possible’ (Barlex and Welch, 2007: 50).

Hennessy and Murphy (1999) identified two interrelated but distinct aspects of authenticity: personal authenticity and cultural authenticity. An activity that has personal authenticity requires the students to identify a need that is real to them, and is orientated towards clients and markets that they can relate to. Being in control and having autonomy, including making a range of design decisions, are all part of what creates personal authenticity in the activity. Students will be involved in the context of the problem, which results in the activity to having both personal meaning and relevance. Culturally authentic design activities relate to activity in the world outside school. This implies the teacher needs to clarify the students’ role in the process to ensure the student has responsibility for their learning journey. Activities need to reflect the practice of professional practitioners as much as practicable (Fox-Turnbull, 2006). Design and Technology activities, as far as possible, need to both personally and culturally authentic if they are to provoke a genuine, as opposed to tokenistic, response from students (Barlex, 2007).

Rule (2006) has proposed four broad themes involved in authentic learning: open-ended inquiry; thinking skills; discourse amongst a community of learners; and self-directed learning. These four themes will provide a useful framework within which to assess the authenticity of the students’ *intended* learning experiences.

When focussing on learning and particularly learning outcomes, the assessment of Design and

Technology learning in Key Stage 3 classrooms needs to be reviewed. Within an OBE system, once the learning has been formulated, the assessment of that learning can be planned. However, identifying learning associated with Design and Technology is not easy and consequently planning for assessment of Design and Technology is problematic. Section 3.8 identifies issues associated with assessing Design and Technology learning.

3.8 Assessing Design and Technology education

Assessment is a complex topic (Black and Wiliam, 1998) and one that has become increasingly important in education over the last thirty years, developing a significant international research base. From a pedagogical perspective, formative assessment or Assessment for Learning (AfL) is considered 'central to classroom practice' (DCFS, 2008: 5) creating the 'bridge between teaching and learning' (Wiliam, 2014: 1). Indeed, the boundaries between teaching, learning and assessment have become increasingly difficult to identify. The primary purpose of assessment is to improve students' learning and teachers' teaching, as both respond to the information it provides. However, Weeden et al., (2002) stress the important question, 'what are we assessing and why are we assessing it?' This question needs to be addressed before the planning of any assessment activity in order to ensure the type of assessment is justified.

The assessment framework for Design and Technology involves the assessment of knowledge, understanding and skills alongside an ability to apply and combine these with both practical and cognitive skills when designing and making (Ofsted, 2003). The inter-relationship between the conceptual and procedural knowledge is fundamental to the subject (SEAC, 1992; McCormick, Murphy and Hennessey, 1994). However, what does this inter-relationship look like in terms of learning outcomes? And how would a teacher recognise and plan for the inter-relationship between conceptual knowledge and procedural knowledge? In practice, translating the key concepts and key processes into authentic learning outcomes is a pedagogical aspect of the teaching-learning process that has often been neglected. Thus assessment of Design and Technology learning tends to be based upon one-dimensional aspects of technological activity, for example, the procedural requirements involved in making, or the number of initial ideas. The multidimensionality requirements of Design and Technology, involving, for instance, social, functional, commercial or aesthetic considerations are often taught and assessed separately and not as interconnected, interdependent elements that influence the design development process. As a consequence learning outcomes are often planned and assessed against one particular aspect of Design and Technology learning.

Learning outcomes are predominantly used for assessment purposes, either formative assessment, involving 'the process of seeking and interpreting evidence for use by learners and their teachers to decide where the learners are in their learning, where they need to go and how best to get there' (ARG, 2002), or summative assessment, where the focus is on determining what the student has learnt at the end of a unit of instruction or at the end of a grade level (for example, through grade-level, standardised assessments). This research study investigates the *ELOs* produced during a learning activity, which tend to be used to inform the teacher or student on the potential problems in relation to the *intended learning*, thus supporting the formative assessment process.

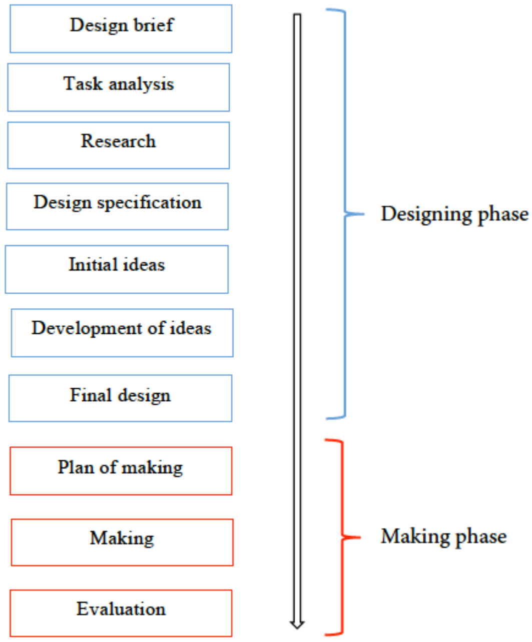
The system of attainment targets and levels introduced in the first National Curriculum (NCC, 1990) attempted to follow a progression model, with each level being designed to comprise progressively more complex statements of attainment. Such an approach views learning as a steady, but continuous rise through the levels, often sub-level by sub-level, with achievement being observable as students perform tasks to show that they have acquired the prescribed skills, knowledge or understanding (Hargreaves, 2005). A conceptualisation of learning as a 'linear track', where students move forward in their learning journey, knowing exactly what lies ahead (Hargreaves, 2005: 220) and providing a predictable, observable and measurable learning experience has, over time, become the dominant model. Such an approach aligns to the concept of 'process-driven task-centered learning' inherent in Design and Technology, where a task is divided into a series of processes or stages and students follow a predictable path towards achieving the task.

The progressive model of learning requires definition of the nature of progression (Wiliam, 2010); that is, when a student improves in Design and Technology, what specifically improves? As Torrance (2002) contends, whilst the attainment targets are progressive in nature, they are not necessarily progressive in learning. In relation to Design and Technology, the attainment targets are simplified, vague statements of learning; for example, 'they show some evidence of creativity as they modify their approach in the light of progress' (DCSF/QCA, 2007: 58), requiring interpretation by the teacher and are evidently subjective in nature (see Appendix B). Daugherty et al. (2008: 223) state 'the loose specification of the curriculum requires teachers to look for translation of the vagueness into explicit requirements', an argument expanded upon by Gardner (2012).

3.8.1 The 'design process' model and assessment

Since the introduction of the first National Curriculum (DES, 1990), Design and Technology has had the common prerequisite to develop skills in designing and making. One of the central features of Design and Technology education is the focus on designing and making activities. Designing and making in schools involves a 'product development process'; that is, a focus on incremental improvements (Veryzer, 1998), more commonly called 'the design process'. The stages of the design process offered a structured format for a formal design process, which Garrett (1991) argues is based on models from industry. The design process recognised by Design and Technology teachers is shown in Figure 3.1.

Figure 3.1 The Design and Technology education design process (adapted from Garrett, 1991).



Generally represented in secondary schools as a linear process, the design process breaks product development down into two activities, designing and then making, and also into discreet sub-stages: the task intention or design brief at the start; the initial ideas section; the evaluation of the development or making at the end. The 1995 National Curriculum (DfEE, 1995) aligned the design process with the process of teaching, learning and assessment in Design and Technology (Kimbell, Stables and Green, 1996) and, therefore, placed it at the center of the subject. Arguably, it has remained there ever since. The benefits and issues involved in adopting the design process model into Design and Technology education will be discussed in detail below; however, it is worth noting that the subject has developed through identifying with this approach at all levels of secondary education in this country (Mawson, 2003). However, the 2014 National Curriculum clearly removes focus from the school-based design process to an *iterative process* of designing (DfE, 2013d) and the advantages of prototyping, trialling and testing to design development, an approach that simulates industrial models of designing.

Although never clarified, the relevant knowledge and understanding was to be applied at the appropriate stage in the design process, presumably identified by the teacher. Lewis (2000, 2004) argues that a common feature, and a concern of the design process model, is the lack of any reference to subject knowledge and how this could either be applied, or at least inform, the designing activity. The inter-relationship between knowledge, skills, understanding and process does create confusion amongst teachers in relation to planning, teaching and learning (Owen-Jackson, 2013). However, a focus upon the design process caused the application of content to become submissive to the individual stages within the process. As Layton (1991) argued, the integrated nature of Design and Technology was lost as the attention was diverted onto the stages of the process. Thus, Design and Technology education adopted a language of 'procedural' knowledge (McCormick, 1997); that is, 'knowing how to do it' knowledge, fostering a notion of design while moving through a procedure (Norton and Ritchie, 2009).

In practice, the design process model reinforced designing and making as two distinct activities; as a result, teachers tended to approach the subject as a 'dichotomous, binary-focused discipline (McGimpsey, 2012). The 'psychological dualism' associated with the design process, which Tomlinson and Swift (1992) identify as a feature of Western culture, has had a significant impact on the way teachers design curriculum activities, leading teachers to conceptualise and plan for the designing phase separately from the making phase.

By simplifying the process into various stages, a prescriptive, sequential, systematic routine has developed with teachers planning activities to address and complement the various stages of the design process. By sub-dividing the design process, the stages themselves take on an exaggerated significance (Borg, 2011), and their relationship to other stages and to the entire process is deemed less significant (Morley, 2002b). Often repeated throughout Key Stage 3, irrespective of the material-focus area or task context, such a routine can result in disengagement in the process and, consequently, students ‘missing the point’ in terms of learning (Atherton, 2013: para. 11), developing a *surface* approach to learning. Hennessey and McCormick (2002: 119) argue the result is a ‘a veneer of accomplishment’ in which students appear to have learnt a process through their use of it, but in fact may not really have understood it or have simply memorised the information. Atkinson (2000) echoes this view, arguing that such a situation hides the *real* processes involved in design and development, while many would argue the valuable learning is lost. Furthermore, Torrance (2007: 291) argues ‘making learning objectives and instructional processes more explicit calls into question the validity and worthwhileness of the outcomes achieved’. This prescriptive approach to teaching was reinforced by teachers’ interpretation of the assessment requirements at GCSE, as Ofsted (2008) stated:

In too many of the schools visited, [meant that] pupils were pushed through a series of hoops, corresponding to stages in designing, to secure marks for their coursework portfolios. (Ofsted, 2008: 49)

The 2007 National Curriculum provided an assessment framework that aligned directly to this linear design process (Appendix B), with students asked to produce a ‘task analysis’ or a ‘plan of making’ as their evidence of Design and Technology capability. Learning outcomes were connected to each of the stages and, therefore, became standardised. This increased focus on the outcomes of each stage in the process resulted in a tendency for them to become ‘well-designed, *sweet-on-the-eye,* products’ (Waters, 2013a), a situation familiar to Design and Technology teachers through the term ‘neat nonsense’. ‘Neat nonsense’ became mildly notorious in the Design and Technology community in the 1990s to describe the time and effort given by students (and teachers) to the *presentation* and *prettifying* of design folios (cited in Barlex and Welch, 2007: 53). The effect was an ‘illusion’ of quality learning through aesthetic influence, the result being an end product that suffers from a lack of authenticity and is rendered superficial.

Illeris’ (2009) ‘assimilative’ theory of learning can be related to the ‘design process’ framework.

Illeris' 'assimilative' learning is based upon 'learning by addition'; that is, learning that is generally built up by means of constant additions to what has already been learnt. Although the stages of the design process are considered separate and distinct aspects, they do present a 'step-by-step' approach, where each step or stage is reliant on, and effected by, the stage before it. The design process model does not reinforce a holistic view of the subject.

From a teaching perspective, making an abstract and/or cognitive process explicit ensures the complexities involved in planning, teaching and assessment of Design and Technology are more manageable (Morley, 2002b). Guiding students through the design process leads to accomplishing prescribed outcomes, and is therefore more convenient, less risky and more predictable in terms of achieving the *intended* learning outcomes. Morley argues that it is natural that the majority of teachers, used to the 'cosy certainty' of technical procedures leading to predetermined outcomes, sought to systematise ways of approaching problems to make 'tangible', inherently abstract, processes for the benefit of both themselves and their pupils (Morley, 2002a: 13). By controlling and managing the design process in terms of inputs and outputs, teachers developed a system that produced the learning outcomes needed to evidence learning.

3.8.2 Alternative approaches to assessing Design and Technology education

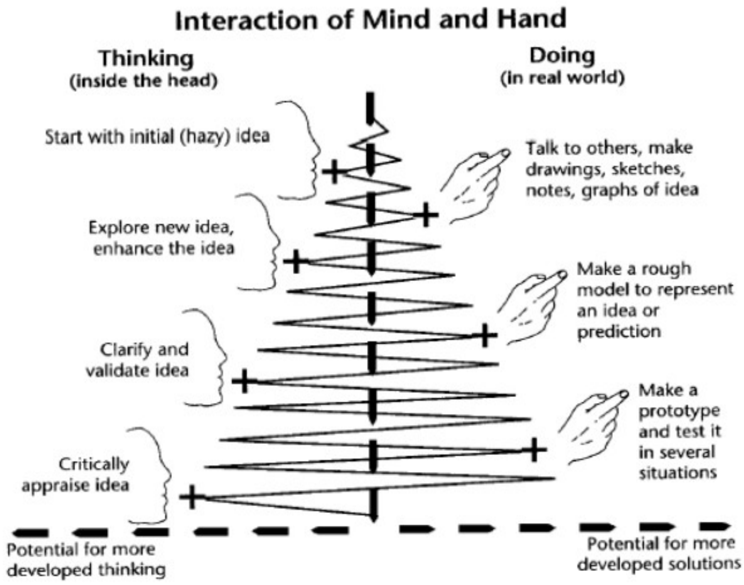
The relationship between designing activities and making activities and the delineation of their boundaries has significant influence on how teachers teach Design and Technology. Placing a greater emphasis on the processes of 'designing and making', rather than the separate aspects of 'designing' and 'making', provides teachers with an integrated and realistic model through which to teach Design and Technology. As Layton (1991) contended, the *unitary concept* with reference to 'designing and making' skills emphasised the intimate connection between the two activities and provides a concept that is broader than either designing activity or technological activity.

Designing and design development is often described as a holistic process (Banks, 1996; Owen-Jackson, 2002), one which requires the student to be mindful of the ‘bigger picture’ irrespective of the particular phase or stage they are currently focusing on. Given this, as Kimbell and Miller argue, ‘designers need to keep the task at the forefront of their thinking and continually revisit it, refining and redefining their understanding of it and consequently their design proposals to meet it’ (Kimbell and Miller, 2000: 123). As with any atomisation process, be it atomisation of knowledge, skills or process, the separation into distinct or smaller units creates confusion in regard to the inevitable interaction of those units (Kimbell, 1997). Both ‘assimilative’ and behaviourist learning processes, involve ‘atomisation’ of knowledge or skills into distinct or smaller units of knowledge/learning and both can be criticised for *isolating* learning. Sadler (2007: 6) explains that, the more a process is atomised, ‘the harder it is to make the bits work together as a coherent learning experience’ and the ‘whole’ is often neglected. Moreland and Jones’ (2000) research into teacher knowledge and Design and Technology education and highlight ‘atomising’ as a common issue with current assessment procedures, concluding that, ‘although tasks are meant to be reflective of technology, they appear to be somewhat isolated experiences, rather than cumulative and purposeful’ (Moreland and Jones, 2000: 230). In this regard, there is compelling evidence that teachers need to identify and plan for specific and overall Design and Technology outcomes rather than just activities (Jones and Moreland, 2005; Moreland et al., 2008).

An ‘integrated approach’ to Design and Technology is clearly represented in the Assessment of Performance Unit’s (APU) model of ‘interaction between mind and hand’, which focuses upon the thinking and decision-making processes involved in ‘designing and making’ (see Figure 3.2 below). The interaction of mind and hand – inside and outside the head - involves more than conceptual understanding. As Kimbell, Stables, Wheeler, Wosniak and Kelly (1991) argue, ‘this inter relationship between modelling ideas in the mind, and modelling ideas in reality is the cornerstone of capability in Design and Technology. It is best described as, “*thought in action”*

(Kimbell et al., 1991).

Figure 3.2 The APU model (Kimbell et al., 1991: 22)



The APU model rejected the prevailing linear model of the design process (Kelly, Kimbell, Patterson and Stables, 1987), instead promoting a view of activity that took the development of a speculative or 'hazy' initial idea to the point of becoming an effective working reality through an iterative process of thought and action. In reality, the APU model involves a 'design and development' approach where testing and prototyping generate further modifications to ideas. The approach encourages teachers to see the process of doing and knowing as an iterative cycle of knowledge in action (Kimbell, 2002), with the emphasis on encouraging and nurturing innovative thinking, growing and learning throughout the process rather than focused on the end results. APU posited this model of interaction between mind and hand as a new framework for assessment in Design and Technology (Kimbell et al., 1991).

Cognitive processes such as designing often involve 'tacit' knowledge, that is, 'a range of conceptual and sensory information and images that can be brought to bear in an attempt to make sense of something' (Hodkin, 1991: 256). Introduced by Michael Polanyi in 1967, 'tacit' knowledge refers to a 'pre-logical phase of knowing' (Polanyi, 1967: 4) and is described as the informed guesses or hunches that are part of an exploratory act, motivated by what Polanyi describes as 'passions'. 'Tacit' knowledge is inherently personal, thus pedagogical methods and strategies for revealing the processes associated with such knowledge are key to the effectiveness of the approach. In contrast to the 'design process' model, which provides both easily accessible and assessable learning outcomes, this aspect of the APU model does not align with an outcome-based education system.

The 'integrated approach' has a significant influence on the choice of teaching strategy, the learning opportunities and the learning outcomes and aligns with a constructivist approach, namely facilitation of learning, learner-centeredness, active and participative learning, creative and critical thinking and problem solving (Reddy et al., 2003). The approach to teaching Design and Technology taken by teachers participating in this research study will be revealed in their lesson planning and *intended* learning outcomes. However, the APU model raised several issues in relation to assessment, not least the fact that some see the 'thinking and decision-making processes' inherent in the approach to be both invisible and, thus, often inaccessible (Kimbell, 2003). The APU model was never thoroughly embraced by the teaching community due to a lack of clarity regarding the form of learning outcomes and the absence of a practical assessment framework (Fox-Turnbull and Snape, 2011).

Project e-scape (Kimbell, 2006, 2008) provides an innovative way of accessing 'design thinking' and 'cognitive thinking processes'. Through the use of hand-held PDA (Personal Digital Assistant), students who took part in the project document their design development in real time through drawing, typing, audio and video recordings and photos, as they progress through the task, providing a detailed account of their design thinking and decision-making processes. The focus on collecting and gathering the learning outcomes in 'real time' is thought to render the information both authentic and valid. Kimbell (2008) argues that assessment requirements must not interfere with the process of designing, and that collecting evidence for assessment should help scaffold the progress of the activity and the performance of learners (Kimbell, 2008). Through project e-scape, the learner's portfolio is used as a device to 'underpin the learner's metacognitive growth throughout the Design and Technology process' (Kimbell and Stables, 2007: 217). Hope (2009) describes the process as a cognitive journey.

Barlex's (2008) *minimally invasive* approach to assessing Design and Technology learning also relies on revealing 'design decision-making', which Barlex believes lies at the heart of Design and Technology education. Opportunities for students to reflect on, and reveal, their progress in making design decisions as the task progresses would be planned into the project; therefore, as Barlex argues, 'essentially the assessment exercise has to probe and record chronologically the pupil's thinking' (Barlex, 2008: 53). Arguably, the *minimally invasive* approach removes the focus from the various stages of the design process and places it firmly on the student's personal learning journey. Barlex argues the process of designing needs to provide evidence of learning, a natural by-product of the learning, captured and gathered in an unobtrusive a way as possible, in order to retain their validity and reliability. Both approaches to assessing an 'integrated approach' to Design and Technology would provide distinctly different learning outcomes when compared to the design process model.

3.9 Transforming learning intentions into learning opportunities

The processes and possibly influences involved in translating planned *intended* learning into *actual* learning outcomes are particularly significant to this research study. The transformation process relies on integrating subject expertise into devising appropriate learning activities (Swaffield, 2009). In relation to teaching a particular discipline or 'form of knowledge', a teacher aims to transform their subject knowledge into what Shulman (1986) called Pedagogical Content Knowledge (PCK). Defined as teachers' interpretations and transformation of subject-matter knowledge in the context of facilitating student learning, PCK is 'that special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding or knowledge' (Shulman, 1987: 9). PCK is developed through teachers' planning, preparation and teaching and lies at the foundation of transformation in the context of teaching. This research study aims to reveal the 'transformation processes' used by teachers to translate the *intended* learning into learning outcomes.

Hill and Ball's (2004) research into teachers' mathematical content knowledge for teaching concluded that professional development, specifically targeting learning in content knowledge, had a significant positive effect on teachers, and that it is possible to successfully design programmes that improve teachers' content knowledge for mathematics teaching. Hill and Ball do contend that the requirements and, consequently, the constructs of the subject in schools is relatively uncontested and accepted by the mathematics teaching community. An international discourse involving Design and Technology education and PCK can be established with several studies exploring the role of PCK in Design and Technology education (De Miranda, 2008; Jones and Moreland, 2004; Rohann, Taconis and Jochems, 2010; Mishra and Keohler, 2006). Defining PCK in Design and Technology is difficult without a clear, agreed content and associated pedagogy. Williams and Lockley (2012) contend that the lack of a structured epistemology in this field of study has resulted in a reduced focus on Design and Technology and PCK.

In respect to Design and Technology teaching, PCK involves an understanding of how particularly challenging Design and Technology concepts might be taught effectively (Koehler, Mishra and Yahya, 2003). As Shulman stated, 'it involves an understanding of how particular topics, problems, or issues are organised, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction' (Shulman, 1987: 8). Design and Technology teachers, irrespective of their experience, often lack a deep conceptual understanding of their subject matter, having disjointed and muddled ideas about particular topics (William and Lockley, 2012). This misunderstanding is compounded by placing focus on the inter-relationship between the various forms of knowledge required in the discipline. Challenging concepts or topic areas, for example teaching of dimensionality, creativity, meaning, and design appreciation, require an interaction between several of the Design and Technology key concepts. PCK involves an awareness of the presumptions and intuitions students bring to the lessons and how to develop these, often requiring the design and use of specific resources and support materials (Nicholl et al., 2013). These matters are significant, as high levels of PCK have been linked to increased student achievement (Hill, Rowan, and Ball, 2005; Johnson, Kahle and Fargo, 2007; Jones and Moreland, 2005).

Whilst based on Shulman's work, the model of 'professional knowledge' by Banks, Barlex, Jarvinen, O'Sullivan, Owen-Jackson and Rutland (2004) provides a Design and Technology perspective on the concept of PCK, referring to a teacher's 'professional knowledge' as involving, subject knowledge, pedagogical knowledge, school knowledge, and a teacher's personal subject construct. A personal subject construct is 'a complex amalgam of past experiences of learning, a personal view of what constitutes "good" teaching and a personal belief in the purposes of the subject' (Banks et al., 2004: 41) and lies at the core of 'professional knowledge'. Presumably, the key concepts should be identifiable in teachers' subject knowledge and personal subject construct. Evidence of what constitutes 'good' teaching in Design and Technology, and 'personal subject constructs', may be revealed in the lesson planning and observation of the learning activity and will directly influence the learning outcomes.

3.10 Design and Technology learning outcomes

The purpose of a learning outcome, as a support for the teaching-learning process, is identified and designed by the teacher and typically used for formative purposes, although learning outcomes can support summative assessment processes. Hargreaves (2005: 218) distinguishes two distinctly different meanings for assessment used by teachers, namely ‘assessment as measurement’ and ‘assessment as inquiry’. ‘Assessment as measurement’ involves a judgement of the level of success or proficiency that has been obtained at the end unit or work or Key Stage and is often synonymous with tests and ‘summative’ approaches to assessment. The ‘assessment as measurement’ paradigm often involves a comparative judgement made by the teacher against some standard or benchmark. Learning outcomes associated with this approach to learning would ideally be predetermined by the teacher in order to allow for easy comparison and rank ordering against the *ILS* (Nitko, 1995). Indeed, schools reporting systems are often based upon standardisation and moderation of learning outcomes. Hargreaves’ (2005: 219) second distinction, ‘assessment as inquiry’, involves a ‘deeper understanding of individuals as learners’ and, in part, aligns to formative assessment principles (ARG, 1999). In order for teachers to gather the necessary information about learning, and provide the necessary feedback to students, teachers and students need to develop a mutually beneficial, interactive relationship.

To fulfil the requirements of both assessment paradigms, learning activities need to generate evidence that learning has taken place. Such learning outcomes provide the evidence of learning progress, a key indicator of successful teaching (Ofsted, 2014a), which can then be used for either summative or formative purposes. Hussey and Smith (2003) argue a ‘range of learning outcomes’ will emerge from any learning opportunity, some relatively close to the *intended* learning outcomes and some that are less directly connected, but nevertheless contributing to the student’s knowledge of the subject in general (Hussey and Smith, 2003: 363). The degree of learning can then be judged against the *intended* learning outcomes specified by the teacher.

The range of learning outcomes generated by the teaching-learning process in Design and Technology reveals a complex and interrelated range of knowledge types (Moreland, 2008). Theoretically, the learning outcomes planned by teachers and produced by learners should be able to be classified into the 2007 key concepts and key processes for Design and Technology and should involve both ‘knowing’ and ‘doing’, procedural and conceptual aspects of the subject. Planning learning outcomes that allow students to demonstrate the inter-relationship between the knowledge forms in Design and Technology is difficult. Presumably, the prescriptive design process model associated with Key Stage 3 teaching and learning tends to limit the range of learning outcomes produced.

It can be argued that, in order for students to refine their learning outcomes and determine appropriate assessment criteria, ‘deeper cognitive, metacognitive and self-regulatory resources must be brought to bear in a deliberate and focused manner’ (Zimmerman, 2008: 23). By placing the focus on the individual ‘cognitive journey’, students – and not teachers – develop the declarative, procedural, and contextual knowledge required in Design and Technology learning. This raises questions about the type of knowledge that is missing from the school curriculum and, consequently, the forms of knowledge from teaching and learning experiences in the Design and Technology classrooms. Self-regulated *expert* students always possess conditional, strategic and metacognitive forms of knowledge in order that they can solve problems in authentic contexts (Paris, 2001). Yet, as Goodwin (2013) argues, Design and Technology rarely acknowledge and/or nurture the development of these forms of knowledge. By ignoring certain knowledge forms or by focusing only on a specific sub-set of knowledge within a general category, e.g. procedural knowledge, the processes that are necessary to develop flexible and adaptable thinking are greatly constrained and devalued (Goodwin, 2013).

In practice, the learning outcomes commonly associated with Design and Technology learning tend to involve aspects of either 'designing' or 'making, having either a written, sketched or drawn, or 3D/*realised* form'. Research into the nature, scope, or type of Design and Technology learning outcomes has been seriously neglected, and in particular how practical outcomes contribute to the theoretical perspective associated with Design and Technology. If teachers find it difficult to see the inter-relationship between technological content knowledge, skills, attitudes and values and technological capability, then the learning outcomes they design will be lacking in relation to demonstrating the nature of Design and Technology education (Reddy, Ankiewicz and Swardt, 2005).

3.11 Summary of Chapter Three

Design and Technology has struggled to create a sound foundation within the National Curriculum due, in part, to the nature of the subject and the variety of learning types involved. As with all subjects, Design and Technology learning focuses upon knowledge, skills and understanding, but also processes, while identifying and assessing the inter-relationships between procedural and conceptual knowledge is difficult.

Cautiously introduced into the first National Curriculum in 1990, the linear design process lies at the heart of the subject and has dominated teaching, assessment and learning. Promoted by various revisions of the National Curriculum, the design process emphasises procedural knowledge and is often attributed to the 'uniqueness' associated with the subject. The design process fits neatly into an OBE approach; indeed, the current *obsession* with outcomes complements the current use of the design process, producing standardised prescribed learning outcomes at every stage. A making-centric view of the subject is prevalent.

A key concern is the lack of attention given to the less accessible and, thus, assessable learning aspects, particularly evaluation and designing skills, which tend to be neglected. The focus upon products at the cost of process is a conflict exacerbated by the current pedagogical framework and has proved difficult to address.

The introduction of the key concepts in the 2007 National Curriculum should have resolved issues with clarity of purpose; however, key concepts are complex ideas, requiring agreement, acceptance and assimilation by the teaching community concerned to be effective. How useful the key concepts have been for teachers is questionable, and arguably they may even have created more tensions in relation to *classroom-based learning*.

Chapter Four reviews the current research on planning in relation to transforming *intended* learning into *actual* learning, exploring the processes and procedures Design and Technology teachers use to plan effective learning journeys.

Chapter Four: Planning for teaching and learning

This chapter focuses predominately on teacher intention in relation to pedagogy and examines the key aspects of, main influences on, and the main issues involved in the teacher's planning processes and procedures. In particular, the usefulness and effectiveness of the planning approaches used in schools by Design and Technology teachers will be examined and the impact of the 2007 National Curriculum framework on these approaches.

In this context, *planning processes* refer to the series of actions or steps whether cognitive, physical or social that teachers take in order to 'design' a lesson (Wei Bain, 2012), and can be described as 'personal' (John, 1991). In contrast, *planning procedures* relate to an established or official set of actions generally set down by the school and, as such, involve a more formal or standardised approach; for example, a school's marking or assessment procedure. The terms 'pre active' and 'inter active' (Jackson, 1968) will be used to differentiate the phases of the teaching-learning process that are particularly relevant to this research study; that is, the 'pre active' phase providing the *intended* learning focus, and the lesson or 'inter active' phase producing the *actual* learning outcomes. Learning intention, teaching strategies, methods of revealing and then capturing learning for assessment purposes will form the structure of the chapter.

Whilst the actual process of teaching and the subsequent learning that takes place is difficult to exemplify, planning is the initial phase in a teaching-learning process, and is often overlooked in terms of teacher support, guidance and academic research. Indeed, research into planning is predominantly focused upon how novice teachers learn to plan and master the process of transforming and adapting the curriculum into learning experiences and opportunities (Clark and

Lampert, 1986). Furthermore, research into the planning processes and procedures used by more experienced teachers is often disregarded, particularly in relation to subject specialisms, such as Design and Technology. This research study will focus upon the short-term planning required for day-to-day teaching and learning and involves Design and Technology teachers in at least their second year of teaching.

4.1 Planning processes and procedures

Planning is an activity in which all teachers engage and is central to their teaching. The practices of planning are as important as the practices of teaching (Carlgren, 1999); through the process of planning, teachers are able to learn about teaching and, through the practice of teaching, they are able to learn about planning (Muttton, Hagger and Burn, 2011). Planning, defined by Sardo-Brown as 'the instructional decisions made prior to the execution of plans during teaching' (Sardo-Brown, 1996: 519), has long been seen as the context in which teachers make a range of important and complex decisions (Clark and Peterson, 1986). Predominantly taking place during a 'pre active' planning phase of teaching (Jackson, 1968; John, 1991), planning provides an opportunity for teachers to formulate their reflections and consolidate their ideas, evaluating and selecting teaching methods, materials and resources. The 'inter active' phase provides the learning opportunities designed during planning, ideally generating the *teacher-student* relationship (Bell and Dale, 1999), and producing the *intended* learning in the form of the *intended* learning outcome.

Hagger and McIntyre (2006) argue that the distinction between the 'pre active' phase of teaching-learning process and the 'inter active' phase should not be exaggerated, as the teacher's thinking is similar between the two phases. Thus, the planning process does not stop once the lesson has been planned or the lesson has been taught and can be seen as a continual thought process. The notion of a continual thought process is reinforced by Clark and Peterson (1986), who propose a third phase in a teaching-learning process, namely the 'post active' phase, to describe the period when teachers reflect on their teaching after a lesson and make decisions about subsequent teaching. Reflections in the 'post active' phase often serve as input for the planning in the 'pre active' phase; thus, the entire planning process can be seen as a constant, cyclical process of continuous refinement, much the same as the cyclical *action research* process (Mertler and Charles, 2008) or *learning cycle* introduced by Kolb (1976).

Shavelson and Stern (1981) propose an additional planning stage, which takes place during the course of *classroom-based learning* during the 'pre active' phase. This additional phase involves 'a form of instinctive, improvised decision-making' (Shavelson and Stern, 1981: 457) and tends to occur in circumstances where the routine or lesson is not going ahead as planned. Improvisational teaching is particularly interesting when considered within a Design and Technology *classroom-based learning* environment, where 'open-ended' tasks and the creative potential of designing requires risk-taking and student autonomy (Miller, 2011), and requires a teacher who understands the need for a responsive, intuitive, *bespoke* learning journey. In contrast, tasks designed to produce identical outcomes via a prescribed design process, managed entirely by the teacher, would not require such teacher improvisation.

Feedback from formative assessment activities could inform improvised decision-making in relation to the needs of the class and the *ILS.* Tsui (2002) contends that, in such a situation, teachers are unlikely to consider alternative plans and are more likely to improvise. Sawyer (2011) argues that a lack of advice for, or discussion with, novice teachers on planning for improvisational teaching reinforces the focus on careful planning in the 'pre active' phase, rather than in the 'inter active' phase, and creates an unrealistic expectation for the novice teacher in relation to *intended* teaching and learning. Evidence of improvisation during a lesson has important implications on the relationship between *intended* and *actual* learning.

4.1.1 The use of planning pro formas

Lesson planning templates or pro formas are a common method used to support the planning of a teaching-learning experience. Built upon the principles that ineffective lesson planning has a dramatic negative impact on classroom teaching and learning and, therefore, achievement (Allwright 2005; Beers 2006; O'Mahony 2006; Panasuk and Todd 2005), lesson planning pro formas tend to complement the dominant approach to planning (see p. 87 below) in both their design and emphasis. Lesson planning pro formas are used predominately by training or 'newly qualified teachers', but also for formal lesson observations either by leadership teams or during Ofsted inspections (Calderhead, 1996). Frequently produced according to standardised formats, the standardised whole school pro forma serves as a means of ensuring that the teacher has taken into account a number of factors in the planning of the lesson itself and students have consistent expectations about learning across all subject areas (DfES, 2004b).

Schools often design the lesson planning pro forma based on either the current Ofsted requirements or a current view of learning or learning theory (Jones and Tymms, 2014). Teachers teaching to inspection criteria and Head Teachers who narrow the curriculum and teaching in order to meet the Ofsted framework is commonplace in secondary schools (Ehren, Perryman and Spours, 2014). Current research studies indicate that Head Teachers focus more on inspection framework priority areas and on improving their capacity-building and school organisation when Ofsted inspections are imminent (Courtney, 2012; Baxter and Clarke, 2013). Thus, it is argued that standardised lesson pro formas reinforce a 'sense of control' in teachers (John, 1996: 487).

The level of prescription included in the planning pro formas has tended to impose rigid frameworks on the nature of teacher plans, with many of the models fitting John's (2006) critical description of a 'system' approach, where the steps in the model lead to, or emerge from, the aims and objectives in a linear, ends-means sequence. Thus, creativity and ownership are eliminated from the planning process. ‘The creative, problem-solving, intellectual aspects of planning and teaching become lost as teachers are encouraged to conform to rigid templates’ (John, 2006: 495). In his review of research on the thinking of experienced teachers while planning, Calderhead concludes that, notwithstanding the variety of methodological approaches employed, ‘six key characteristics of teachers planning processes can be identified: planning occurs at different levels; is mostly informal; is creative; is knowledge-based; must allow flexibility; and occurs within a practical and ideological context’ (1996: 713). Calderhead’s key characteristics conflict with the dominant approach to planning and the use of lesson planning pro formas, with particular tensions in relation to the creative and flexible requirements of effective planning.

In England over the last twenty years, the extent to which flexibility and creativity have been a feature of experienced teachers’ planning is open to question given the range of National Strategies operating, which have brought with them specific expectations of how ‘effective’ lessons should be planned (DfES, 2004b). Prescriptive in its nature, the National Strategy guidance, *unit 1: Structuring learning,* introduced a process of lesson design which involved: locating the lesson or sequence of lessons within an appropriate context; identifying the learning objectives; structuring the learning episodes into distinct stages or steps, each with a specific outcome; and, finally, ensuring coherence throughout the lesson episodes from the start to the plenary (DfES, 2004b: 4). Whilst teachers work within such a tight planning framework and under such regulatory conditions, there is little room for a creative approach to planning, teaching or learning (McLellan and Nicholl, 2008b). As Hussey and Smith posit, ‘the fog of rhetoric and justification threatens to stifle originality and responsiveness within classrooms’ (Hussey and Smith, 2003: 358).

In order to effectively support teachers’ planning, the pro forma needs to support teachers’ lesson planning processes, being based upon a model that is theoretically grounded and practically relevant for teachers and support the decision-making requirements inherent in the planning process. John (2006) argues the design of the lesson planning pro forma needs to be both dialogical and problem-solving in conception, as well as supporting the formulation of teachers' reflections and consolidation of their ideas. However, Leinhardt (1988: 47) argues 'teachers are precise, flexible and parsimonious planners and plan what they need to but not what they already know and do automatically'. Indeed, this would infer that the lesson plan would not include excessive details in every instance, but rather aspects of the teaching-learning process that the teacher is least experienced with. This notion will be a focus in analysing the lesson plans in this research study.

4.2 Models of planning for learning

Rationalistic, technical curriculum planning has been the dominant model underpinning planning for teaching and learning for a generation or more in England and Wales (Parkay and Hass, 2000) and involves the use of a linear approach to planning, which begins with the specification of objectives and ends with a lesson evaluation. The Key Stage 3 National Strategy for Design and Technology (DfES, 2004b), for instance, suggests the following format as a framework for planning: objective; vocabulary; resources; starter; main activity, and plenary. This dominant or 'rational' approach to planning is based on Tyler's (1949) model of curriculum theory and practice, comprising a systematic approach based upon the formulation of behavioural objectives, thus providing a clear notion of *outcome*, so that content and method may be organised and the results evaluated. It considers education to be a technical exercise of organising the outcomes or products of learning, whereby objectives are set, a plan drawn up and applied and the outcomes (products) measured. Snape (2013) provides an example of what he defines as 'quality learning' through such a technical, sequenced linear pathway, including: the *intended* learning; teaching episodes; opportunities for tangibly evidenced student work; and criteria for successful achievement.

The dominant approach to planning has several benefits for teaching. Objectives that clarify the learning can assist the planning process, thus providing a solid foundation for planning subsequent learning activities and learning outcomes (Marsh, 2004). Consequently, the 'dominant' planning model is favourable when introducing student teachers to the complexities of planning, not least because the attraction of this approach to planning lies in its 'elegant simplicity' (John, 2006: 485). By approaching the teaching-learning process systematically, the opportunity to modify the inputs to enable the optimal assimilation of knowledge and skills to take place during the learning process can be achieved, thus maximising the quality of the outputs (Hussey and Smith, 2003) and aligning to an OBE system (see p. 35).

However, such a systematic process obviously bears little relation to the thinking, decision-making and actions of teachers in the context of the classroom. Students' responses create an ever changing dynamic for teaching - one that is, in no sense, predictable or 'prescribe-able' (Ben-Peretz, 2001). The dominant planning process considers *classroom-based learning*, as neat, clearly defined, with often disconnected elements. Such a limited view of teaching and learning (John, 2006) involves a limited view on the teaching strategies employed by teachers and, thus, inevitably generates a limited range of learning outcomes. As Nuthall (2008) contends, if research on classroom learning is to have both the theoretical and practical validity required to be useful to teachers, it needs to take account of the fact that every aspect of classroom life is complex, multi-layered, and context-dependent (Nuthall, 2008: 209). Indeed, the fundamental principles of the dominant approach to planning are often difficult to translate into a classroom setting, and particularly difficult to translate into a Design and Technology classroom where learning is multifaceted, multimodal and multidimensional (Moreland, 2008).

Calderhead (1996), like Clark and Peterson (1986) before him, argues that experienced teachers rarely follow a rational model of planning, rather a 'creative, interactive, problem-finding and problem-solving process of planning' (1996: 15). In reality, the dominant planning model tends to contrast with more experienced teachers' approaches to planning (John, 1991), thus raising issues around the effectiveness and usefulness of the dominant planning model for teachers and raising questions regarding the role and/or function of such an approach. Zahorik (1970) and Taylor (1970) showed that teachers actually prioritised subject content as the most important planning category, followed by the teaching-learning activities, with aims and objectives the least frequently mentioned area of concern for teachers. John (1991) supports this view, concluding that teachers' planning processes involve 'looking for good ideas and then for ways of translating these ideas into workable classroom activities' (John, 1991: 306). Whilst the 'dominant' planning process may be a useful approach when teaching student teachers to plan, as a process it significantly conflicts with teaching practices in the classroom.

4.2.1 Alternative planning models

Several alternative and adapted planning approaches are present in the current literature, which are particularly pertinent to Design and Technology education. Borko, Livingston, McCaleb and Mauro (1988) suggest that patterns of planning are very much related to a teacher's subject specialism and provide a range of alternative or modified planning models. Although teachers' approaches to planning have generic outlines, a number of individual variations exist which are very much dependent upon the teacher's view of the teaching situation and their own beliefs, values, attitudes and concerns (Tsui, 2002). In particular, a teacher's own perception of their subject had a strong influence on the formation of their ideas about planning (John, 1991). In this regard, Tsui (2002) contends that teachers plan in a way that suits their own personal style. This question of whether planning processes or procedures are subject-specific can be specifically related to whether Design and Technology teachers approach planning in a particular and unique way. John's (1996) research on trainee teachers' planning processes found that mathematics teachers saw their subject as a predominantly hierarchical subject involving a logical, staged progression of understanding (Hill, Rowan and Ball, 2005). As such, planning focused upon facilitating that understanding by building carefully on each previous stage of the work covered. In contrast, trainee geography teachers had no clear shared definition of their subject and their approach to planning was less structured.

The 'naturalistic' or 'organic' model, based on the work of Stenhouse (1975) and Egan (1992; 1997), was developed from the apparent conflict between the need to carefully specify learning intentions and the dynamic nature of classrooms, and was an attempt to emulate a realistic planning process based on the 'natural' interactions in a classroom. Naturalistic planning involves starting with activities and the ideas that flow from them before assigning learning objectives (John, 2006). Although lacking detail in terms of pedagogical requirements and consideration, this model does resonate with Perkins, Tishman, Ritchart, Donis and Andrade's (2000) notion of 'learning in the wild', when learning settings are recognised as 'messy and complex' (Carr, 2008: 36). Perkins and Saloman (1992) argue for the need for learners to experience more 'natural' learning environments, with teachers' planning procedures supporting this notion.

Within a Design and Technology context, 'wicked problems or tasks' (Rittel and Webber, 1973) described as 'problems of deciding what is better when the situation is ambiguous at best' (Marback, 2009: 399), support the 'naturalistic' model, as wicked problems are not solvable; they are contingent problems of deciding what to do that require continual evolution and, as such, are based upon the continual morphing of ideas and idea development, through a problem-solving process (Kimbell, Saxton and Miller, 2000). Such a 'naturalistic' model requires teachers to plan and create realistic design scenarios in order for students to learn the authentic nature of design activity, thus allowing students to experience environments where experimentation and exploration are dominant approaches.

The ‘interactional method’ of planning, another alternative to the dominant model, stresses the interactive nature of learning and, therefore, learning objectives (Brady, 1995; Bell and Lofoe, 1998). Whilst the ‘interaction’ model specifies the same design elements as the linear objectives model (such as *ILS* and *ELOs*), the ‘interactional method’ planning process can begin with any of the elements. Based on this model, all curriculum elements interact with each other during the design/planning process and, therefore, the design of one element will influence and possibly change the design decisions for other elements. For example, method might be specified first, but altered later as a result of an assessment decision. From a practical perspective, this model makes it possible to specify learning objectives after all other elements have been decided (Bell and Lefoe, 1998).

The ‘articulated curriculum’ (Hussey and Smith, 2003: 360) provides a similar approach to the ‘interactional model’, where the respective elements exist in a state of mutual interaction and influence. Alexander (2000) compares this ‘articulated curriculum’ approach to planning to the structure of a musical performance, where the composition is analogous to the lesson plan, and the performance shifts according to interpretation and improvisation. This ‘responsive’ approach to planning requires the teacher to be vigilant of the learning progression within the class and respond accordingly, and is synonymous with the formative assessment principles of ‘feedback’ (Ramaprasad, 1983) (see p.100). Biggs (1999) notion of constructive alignment also supports this way of approaching planning for teaching and learning.

Clark and Yinger (1987) claim that teachers use a number of different types of planning approaches, both pre-teaching and during teaching activities, suggesting that teachers require a ‘repertoire’ of planning approaches for different requirements, including different pedagogical approaches. One such example is characterised as a *mental rehearsal* of ideas and knowledge about students, the school and the curriculum. Here, ideas are formed which, after elaboration, develop into mental plans or images (Morine-Dershimer and Vallance, 1976), and act as a classroom script or guide. Such mental images of a lesson provide the teacher with a visual story or journey, which can be rewound and redirected at any time.

This type of planning approach would support the 'improvised' planning required during a lesson through the rehearsal of a variety of different *scenes* or possible outcomes. The significance of scenes or images in planning and teaching, particularly for experienced teachers, appears to be very important when preparing to teach (Olsen, 1982; McIntyre, 1988). Clandinin (1985; 1986) describes the images as 'shaping devices' that act on the way teachers view the future teaching situation, while Schank and Abelson (1977) demonstrated that often the term 'images' can refer to snapshots of perception that flit in and out of the teacher's visual memory as they plan and prepare lessons.

4.3 The National Curriculum and planning processes

Irrespective of the model used by teachers to plan, identifying the learning is deemed essential to the teaching-learning process. The National Curriculum sets out the learning that teachers are required to teach. However, the 2007 National Curriculum, an 'outcome-based' framework, by definition is focused upon the 'outcome', or end, of the teaching-learning process relative to the *ILS*. The dominant planning model clearly aligns with this approach with a particular focus on the *ILS* and the learning outcome. The result is a language of 'ends' and objectives that can be objectively measured, but is established outside the process of being educated; that is, placing the emphasis on 'outputs' of education deflects the focus from the sole purpose of education that is learning (Pring, 2000). In practice, teachers' planning processes become focused on either the product of learning or the tools for measuring the learning and move away from the education process of learning itself (Hewitt, 2013; Harden, 2002). 'Education then, becomes the means to achieve the ends' (Pring, 2000: 26). It is within this context that this research study is located.

In contrast to the 2007 'OBE-influenced', prescriptive approach to teaching and learning, the new statutory English National Curriculum (DfE, 2013a) attempts to provide 'greater flexibility' in terms of planning, while the New Ofsted Framework for inspectors does not require lesson plans to be produced during observations; however, teachers will still be required to deliver well-planned lessons (Ofsted, 2014a). In this regard, guidance on how to actually implement the curriculum is minimal and appears to be the responsibility of the particular subject association, for example *The Design and Technology Association*. The Government suggests that Head Teachers and their staff are best placed to decide what training and resources are needed to support excellent teaching of the new curriculum in their schools (DfE, 2013a). There will be no national rollout of training packages and schools will be expected to prioritise the use of their existing in-service training days to help staff prepare to teach the new National Curriculum. Mitchell (2014) suggests that the lack of guidance and support for teachers' planning processes will result in planning processes remaining the same.

4.4 Planning the *intended* learning

Identifying and formulating the learning is often seen as the starting point of the planning process. Semantics is inherit within any discussion on formulating learning, with the concept of *intended* learning often being referred to as learning objective, intention, lesson aims or objectives, and is sometimes used interchangeably with learning outcome or learning goal. The variety of terms and phrases used by teachers and the teaching community exemplifies the confusion around identification and description of the *intended* learning. Torrance (2007) explains that this confusion results, in part, from the fact that the terms are often conflated, combined or interchanged, which is also apparent in the relevant literature. For the purpose of this research study, and to avoid any bias or confusion, *Intended Learning Statement(s)* (*ILS)* will be used as a generic term to describe intended and predicted *classroom-based learning*.

The National Curriculum provides a framework for identifying and setting out what a learner is expected 'to know', 'to understand' and 'to be able to do' as a result of a learning process. Clarity regarding the specific *classroom-based learning* is emphasised within this framework as an essential requirement for any good lesson design (DfES, 2004b: 4), from both a teaching and learning perspective (Burton, 2000; Hussey and Smith, 2008). The predictive nature of planning often starts with the teacher identifying and then formulating the *intended* or *predicted* learning into a single sentence to be understood by students.

Framing a statement that predicts a student's learning is not easy (Tsui, 2002; Jackson, 2000). As planning is regarded as a psychological process of envisioning the future and of considering goals and ways of achieving them (Clark and Dunn, 1991), *classroom-based learning* will always require a conscious intention by the teacher. However, *ILS* are sometimes written in terms of teaching intention while, at other times, they are written in terms of expected learning. There is confusion in the literature in terms of whether objectives belong to the teacher-centered approach or the outcome-based approach (Moon, 2002).

ILS are often criticised for their inadequacy as predictors of learning (Stenhouse, 1975; Eisner, 1967). Hussey and Smith (2002) are of the view *ILS* cannot be made precise by being written with a prescribed vocabulary of special descriptors, while Sadler (2007) contends that learning simply cannot be conceptualised as neatly packaged intentions and procedures. Furthermore, Drummond (2008) argues that *ILS* cannot identify or describe the full range of *classroom-based learning*, let alone the entire continuum of learning types. Such contentions have a particular relevance to this research study as such a suggestion renders *ILS* potentially useless in practice.

In reality, the National Curriculum attainment targets, originally designed as holistic statements to support and guide teacher assessment at the end of a Key Stage, are used extensively in schools as the framework for formulating *intended* learning (Gipps, 1995). As such, assessment dominates the formulation of learning into *ILS* and the identification of associated learning outcomes is consequently aligned. This 'over emphasis' on the function and role of assessment is frequently cited in the literature associated with the 2007 National Curriculum (see Hargreaves, 2005; Stobart, 2008; Wiliam, 2000). Hewitt (2008) discusses the implications of using an assessment system to plan teaching and learning.

The 2007 level descriptors used for assessment were clearly synonymous with an outcome-led, behaviourist approach to learning (Dann, 2002). Teachers devised systematic ways to ensure both learning and learning outcomes could be easily recognised, produced and gathered, by emphasising performance (Hargreaves, 2012). Arguably, accountability issues forced teachers to develop a systematic approach to teaching and learning in order to overcome issues with loose definitions, vague descriptions and issues with progression, implicit in the 2007 assessment framework (Sadler, 2007; Thompson and Wiliam, 2007). 'The Importance of Teaching' White Paper, published on 24 November 2010, set out the Government's commitment for schools and colleges to be directly accountable for the education they provide. The school performance measures referred to as 'floor standards' for primary and secondary schools, or 'minimum standards' for 16-18 education (Gov.uk, 2013) are used by Ministers to set standards for the purpose of holding schools to account. The introduction of such 'floor standards' and 'league tables', often called 'performance tables' (DfE, 2013c), has had significant impact on the day-to-day priorities of a teacher and, in particular, their use of learning outcomes. The need for schools to monitor the progress of their students more regularly can be directly related to the introduction of 'floor standards' and 'league tables' (Cassidy, 2014).

The Key Stage 3 National Strategy (DfES, 2004a) provided guidance on how to formulate *ILS* and suggested that an *ILS* would fit into one of the following five categories of learning: acquiring and applying knowledge; acquiring concepts; acquiring new behaviours or new skills; exploring attitudes and values; and personal growth, developing creativity. Clarke (2005) endorses the use of these categories, explaining that, since the introduction of the 2007 National Curriculum, knowledge, skills and understanding have provided a clear focus for writing *ILS*. As such, the anatomy of *ILS* tends to follow a prescribed format, for example 'to understand' or 'to know' or 'to be able to'. Snape (2013: 141) argues the focus needs to be on the relevant skills, knowledge, understanding and applications that the teacher has identified as 'critical to the learning process'.

At all levels of education there is substantial guidance for teachers on writing *ILS*, often contradictory and inconsistent. Generally, advice follows Kelly (2013) who contends that, for *ILS* to be complete and effective, they must include two elements: they must define what is going to be learnt and, secondly, they must give an indication of how that learning will be assessed by stating the form of the learning outcome, that is determining the actual product, process or outcome (Eisner, 2002). Clearly, the more precise the learning statement is in terms of defining the *intended* learning, the easier it is to assess the *intended* learning demonstrated by the learning outcome. The more precise the identification of the *intended* learning, the easier the statements are to compose and the clearer they are (Kennedy, Hyland and Ryan, 2012).

The National Strategy materials (DfE, 2004c: 2) suggest 'teachers need to decide in advance what they want as an outcome, not only in terms of a product but also in terms of the outcome's quality and quantity'. The quality and quantity in relation to *ILS* are often presented as success criteria. This requires the teacher to understand what constitutes an appropriate learning outcome and the requisite quality or attainment level demonstrated by the learning outcome (Moreland, 2008), such that the learning outcome can be assessed against the success criteria.

When writing *ILS* teachers often incorporate the context of the activity. Gardner (2006) contends that, by muddling the context with the focused or *intended* learning, the desired intent can be compromised, thus placing the focus on the activity as opposed to the learning. In this regard, Clarke (2005) argues that, by separating the *ILS* explicitly from its context, students can see the application of the learning within a number of different contexts, and 'transferability' of knowledge, skills and understanding in other context, or even subject areas, becomes easier for the student. Decontextualisation of formal learning experiences, or learning that is detached from the contexts in which it derives meaning (Choi and Hannafin, 1995) in a cognitive framework, results from the primary focus being placed on the learning process itself or on the task (Anderson et al., 2000), and thus aligns with Clarke's (2005) argument above. However, Hussey and Smith (2003) argue that, unless learning statements are contextualised, they become harder to interpret by students. Decontextualised *ILS*, disconnected from the learning activity, become meaningless in terms of learning (William, 2013). This results in students seeing learning activities as a series of 'hurdles' which need to be cleared, thus reinforcing the prescriptive approach to teaching and learning. Edwards (2005) extends this notion by contending that learning outcomes cannot be separated from the experiences that produce them; in other words, the authenticity of the learning situation is representative of the learning outcome.

In relation to Design and Technology, teachers often confuse *intended* learning with *intended* activities, focusing upon what the students need to do in a lesson rather than learn from a lesson (Eraut, 2000). In relation to planning, Ofsted's Design and Technology in schools 2007-10 report (2011) concluded that, while teachers often described in detail what students would do in a module or lesson, they did not focus sufficiently on what they would learn. Whilst the procedural nature of the subject lends itself to emphasise the step-by-step actions required to achieve the given task, teachers tend to focus on structuring the work, rather than identifying and then structuring the learning and planning, for learning progress is often neglected. Furthermore, learning by doing is often difficult to identify specifically (Reese, 2011). Whilst the learning activity is clearly important, the nature of the learning outcomes may differ if the focus is on the activity and not on the learning itself.

4.5 Planning to reveal the learning

In order to plan for *classroom-based* teaching and learning, teachers need to know what their learners understand, partly understand and/or misunderstand in relation to the *ILS*. Thus, teachers' planning processes need to include clear intentions regarding how learning can be revealed throughout the *intended* learning journey (Clarke, 2005). The vehicle used by teachers to reveal and/or access students' learning is generally considered to be formative assessment (Gardner, 2006). Rinaldi (2006) argues that, if undertaken effectively, formative assessment reveals the *visible learning* and is crucial in ensuring students' learning. Presumably, the reference to 'the visible learning' is to conscious, deliberate forms of learning (Eraut, 2000).

Whilst a growing emphasis on the use of formative assessment has emerged, formative assessment has remained an *enigma* in the literature (Black and Wiliam, 2001; Leung and Mohan, 2004). Dunn and Mulvenon (2009: 2) describe formative assessment's 'as an ethereal construct' and argues this issue has been perpetuated in the literature due to the lack of an agreed upon definition. Numerous definitions of formative assessment exist (see Black and Wiliam, 1998: 140; Bell and Cowie, 1999: 32; Shepard, Hammerness, Darling-Hammond and Rust, 2005: 275; Kahl, 2005: 11), with various different emphases, functions and forms, adding to the confusion surrounding the precise purpose of formative assessment activities in a classroom setting. Klenowski (2009: 264) contends that formative assessment is part of the everyday practice by students, teachers and peers that seeks, reflects upon and responds to information from dialogue, demonstration and observation in ways that enhance on going learning', suggesting that formative assessment practices are integral to learning progress.

Effective *classroom-based* formative assessment practice is considered a 'key professional skill' for teachers (DCSF, 2008: 5). The formative assessment processes involve eliciting understanding from the learner and using the information to enhance teaching and learning (Carless, 2007). The initial stage in the process can be described as 'seeking' out evidence of learning (ARG, 1999) or, as James (2008: 21) states, 'making observations to elicit information'. Thus, the formative assessment process starts with a conscious intention by the teacher to reveal the learning at appropriate stages in the learning journey and, consequently, needs to be 'part of effective planning of teaching and assessment' (Black, Harrison, Lee, Marshall and Wiliam, 2003: 2-3). Consequently, the 'key professional skill' required for effective formative assessment requires teachers 'devising and constructing tasks to elicit revealing and pertinent responses from children' (Sadler 1998: 80). Seeking or eliciting information regarding student learning involves teachers identifying, and planning for appropriate formative assessment techniques or methods, methods that not only are suited to the particular activity, but are suited to the type of *intended* learning (Moreland, Jones and Barlex, 2008).

Whilst a variety of formative assessment techniques have been developed for teachers to implement (see Angelo and Cross (1993) for a comprehensive account of formative assessment techniques), 'formative assessment is not well understood by teachers and its implementation is weak' (Black and Wiliam, 1998: 20). This position was confirmed in research undertaken by Dekker and Feijs (2005) and by Carless (2007), who suggests that improvements in the implementation of formative assessment depend largely on teachers' understanding of principles and practice of formative assessment. The King's Medway Oxfordshire Formative Assessment Project (KMOFAP) (Black, Wiliam, Harrison and Marshall, 2002) found that individual teachers adopted and adapted different aspects of formative assessment practice and that a *sense of ownership* was developed through finding context specific ways of putting ideas into practice. Black, Harrison, Lee, Marshall and Wiliam (2003:121) state that 'teachers developed not only their practice, but also insights into the nature of learning and the role of the teacher in the cognitive and affective development of the learner'. This position was confirmed by Wiliam (2010), who posits that 'Teachers need to be able to exercise *choice*, to find ideas that suit their personal style, and they also need the *flexibility* to take other people's ideas and adapt them to work in their own classrooms' (Wiliam, 2010: para. 24). The notion of 'ownership' in relation to pedagogical techniques and of 'adapting' or modifying methods in order to suit teachers and student needs is promoted in the 2014 National Curriculum.

4.6 Planning and formative feedback

Feedback is a central practice within the formative assessment process (Swaffield, 2008). It can be described as the 'information about the gap between the actual level and the reference level of a system parameter which is used to alter the gap in some way' (Ramaprasad, 1983: 4) and has its origins in regulatory mechanisms, where part of the 'output' of the system (the learning) is returned or 'fed back' in order to improve performance. Assessment only becomes formative when evidence is fed back into the teaching-learning process in order to meet learning needs (ARG, 1999). Wiliam (2000) contends that the effective use of feedback is a prerequisite of effective learning. The Assessment for Learning strategy (DCSF, 2008) advises that the teacher needs to regularly assess learning and provide specific, positive feedback to inform next steps; furthermore, evidence about learning needs to be used by the teacher to adapt teaching and learning to meet students' needs.

The prescriptive, formulaic nature of planning methods associated with OBE systems tend to be rigid and non-flexible, as seen with the 'dominant approach to planning' (see p. 87). However, the planned teaching and learning journey has to be sufficiently adaptable to respond to the feedback from formative assessment, as highlighted by Wiliam's (2009) definition of formative assessment, that 'an assessment functions formatively to the extent that evidence about student achievement elicited by the assessment is interpreted and used to make decisions about the next steps in instruction that are likely to be better, or better founded, than the decisions that would have been taken in the absence of that evidence' (Black and Wiliam, 2009: 9). Teacher's 'improvised' planning (see p. 84) could provide evidence of effective formative assessment if changes are evident after, or as a result of, a formative assessment activity.

Evidence of learning or learning outcomes gathered during a lesson may be used either 'on the spot' or later to help students or groups achieve the *intended* learning focus (Gardner, 2006). If used 'on the spot', time is needed during the lesson for the evidence to be interpreted by teachers and decisions made in relation to modifications or alterations to the *intended* learning journey. Whilst modifications are necessary, Kimbell (2007b) argues that, generally, such modifications are slight and that evidence from formative assessment 'only alters the planned learning route, and not the end point or goal' (Kimbell, 2007b: 248). The ARG (2002) places a clear emphasis on learners' use of evidence of their learning or learning outcomes. Learners need to act upon information and feedback if their learning is to improve (Broadfoot, Daugherty, Gardner, Gipps, Harlen, James and Stobart, 2002). Planned learning experiences must take this into consideration and provide 'thinking time' for learners to interpret evidence of their learning, and of their peers. As such, implementing formative assessment means that not everything in a lesson can be planned in advance (Gardner, 2006).

4.7 Planning the learning journey

'Generally the learning objective *[ILS]* provides the focus for planning the learning journey' (Spencer, 2003: 251), with the learning journeys being planned as a series of teaching and learning activities designed to accomplish the learning outcomes. Tyler's (1949) rational approach to planning is grounded on the principle that learning is most efficient only if it is properly organised, suggesting that the learning experience should be organised in a way that it will help the students reach the objectives (Marsh, 2007). The National Strategy guidance on 'structuring leaning' supports this approach, stating 'an effective lesson will be organised into a sequence of distinct learning episodes'. However, the document suggests that each episode needs both 'a distinct purpose and distinct outcome' (DfESc, 2004: 4). Furthermore, opportunities for reviewing the learning are encouraged at the end of each episode, implying a series of ILS, formative assessment opportunities and learning outcomes are required for each lesson or learning journey.

'The process of lesson design can be viewed as a series of decisions, each leading to and providing a foundation for the next building a planned series of episodes (DfESc, 2004: 4). In order to demonstrate progression of learning, teachers often design a progressive learning experience where complex activities are atomised into simpler activities and then taught as a series of stages. Such a model is based on reductionist assumptions that knowledge is made up of elementary units of experience, which are grouped, related, and generalised, and that the parts of a given learning experience are equal to the whole (MacInnis, 1995). This reductionist approach to planning teaching and learning has several similarities with a behaviourist view of learning.

The process of atomising learning has been widely criticised in current research on teaching and learning (see Hargreaves, 2005; Kimbell, 2007a; Eraut, 2000; Sadler, 2007). This is primarily because the atomising process does not translate effectively to the more complex categories of learning and, as such, the more complex categories of learning are often disregarded (Eraut, 2000; Hirst, 1974). The concern regarding the assessment of more challenging learning aspects identified in the National Curriculum, such as values, creativity or reflective skills is well documented (Pike, 2007; Richardson, 2010) and is particularly pertinent in relation to Design and Technology education. Learning that is both educationally and professionally significant and worthwhile should not be omitted simply because it is not easy to translate into a statement or is hard to measure (Prideaux, 2000). In this regard, Kimbell (1994) argues atomised learning reduces teaching to a series of simplified, prescriptive steps intentionally designed to achieve the *ILS*.

This reductionist approach – or, as Sadler (2007) describes it, 'fine grained approach' – has been strongly critiqued and a number of concerns identified, including: exclusivity of the procedures; transformation of the creative process into pre-specified products; proliferation of assessment; uncertainty in knowing the judgement on specified detail; and the confusion created by the inevitable interaction of the details (Kimbell, 2007a).

The choice of pedagogic approach and teaching strategy or technique will often depend on the nature of the *intended* learning and the relationship between the educational intentions described by the teachers and the curriculum content and delivery models that they select and implement to achieve those intentions is crucial (Hopper, 1998). Some subjects have a strong leaning towards particular approaches because of the nature of the content and demands of the syllabus (DfES, 2004b). Decisions on a particular lesson with a particular student, or group of students, depends on the interplay between subject and pedagogic knowledge, knowledge of the students and includes a teacher's 'ideas about how learning happens' (Capel, Leask and Turner, 2006: 260).

Transforming the *ILS* into a learning journey involves PCK. PCK is developed through teachers' planning, preparation, and teaching and lies at the foundation of transformation in the context of teaching–teachers transforming content into meaningful understanding by learners. Indeed, the 'way the learning context is structured is a direct result of teachers' pedagogical content knowledge and philosophy about how children think and learn' (Fleer, 1999: 269).

4.8 Formative assessment in the classroom

Purpose and focus, intention, output, setting, and goal all potentially influence the type of formative assessment interaction within the classroom, and several dichotomous classifications of formative assessment exist.

Teachers regularly use two kinds of formative assessment in a classroom, namely *planned* formative assessment and *interactive* formative assessment (Bell and Cowie, 1999). *Planned* formative assessment tends to be carried out with the whole-class, whereas *interactive* formative assessment involves an interaction with an individual or small group. Both types of formative assessment are dependent on teachers' pedagogical knowledge as interacting with the whole class, as opposed to individuals requiring different teaching approaches. There is, however, an issue when assessing a whole class. Formative assessment is based on the teachers' understanding of learners' current position, which will clearly differ from student to student. Whilst learning is acknowledged to be a highly personal/individual process, planning processes, including *planned* formative assessment, necessitates a focus upon some 'collective view' of learners' existing knowledge, skills and capabilities (Kimbell and Stables, 2007: 249). The practicalities of classroom practice require teachers to provide a balance between individual and whole class learning.

Carless (2007) makes a case for an additional type of formative assessment used in a classroom, namely *pre-emptive* formative assessment, described as 'denoting teacher actions which attempt to clarify student understanding before misconceptions have resulted in ineffective learning outcomes and/or loss of marks in assignments or examinations' (Carless, 2007: 171). As a strategy, *pre-emptive* formative assessment has its basis in the centrality of feedback in the learning process, and attempts to tackle the problem that too much feedback comes too late in the process to be of maximum benefit to the learner, in as much as it is not instantaneous. The rationale for *pre-emptive* formative assessment stems from key issues in the provision of useful feedback, namely timeliness and the opportunity for students to act. To address this, Tara (2005) discusses the need for 'iterative' cycles of formative assessment and for revision activities to be designed into the learning experience. 'Short-cycle' formative assessments (Wiliam and Thompson, 2007), or 'rapid formative assessment' (assessments conducted two to five times per week) (Yeh, 2006), have significant effects on improving students' learning. On an even shorter time scale, Black, Harrison, Lee, Marshall and Wiliam's (2003) use of 'in-the-moment' formative assessments provide evidence of substantial gains in student achievement, equivalent to an increase of the rate of student learning of around 70% (Wiliam, Lee, Harrison and Black, 2004).

Evidence of learning or learning outcomes generated through formative assessment strategies can be distinguished as either *purposive* or *incidental* evidence (Wiliam, 2000). *Purposive* evidence relates to the planned, deliberate intention of a teacher, designed to provide evidence about specific knowledge or capability. Purposive evidence needs to be planned and then related back to the *ILS* and will be identifiable in the lesson plans. In contrast, *incidental* evidence of achievement or learning is generated in the course of a teacher's day-to-day activities, generally when the teacher becomes aware of learning having taken place that the teacher previously was not aware of. *Incidental* evidence of learning is 'spontaneously and continuously generated' (Wiliam and Black, 1996: 541) and requires the teacher to be continuously vigilant. As such, it cannot be planned for.

Torrance (2007) introduces the notion of *convergent* and *divergent* assessment events. A *convergent* approach to learning focuses on whether the student has a predetermined specific kind of knowledge, understanding or skill and is synonymous with the dominant approach to planning. In contrast, a *divergent* approach places the teacher's attention on the student and the student's understanding, and aims to reveal this. *Convergent* and *divergent* approaches arise 'from teacher's differing views of learning and the relationship of assessment to the process of intervening to support learning' (Torrance and Pryor, 1998: 153). *Convergent* assessment requires the teacher to 'control' the learning through a tight learning plan of the lesson and relies on the teaching session working according to plan. As such, closed questioning and tasks are common aspects of *convergent* assessment, as is the use of fixed and specific criteria. In such environments, feedback tends to be focused upon completing the task and student errors are contrasted with the *intended* correct responses (Pryor, 2010). *Convergent* assessment has several implications for learning and learning outcomes. Learning is seen as the acquisition of knowledge and, therefore, conforms to a behaviourist view of learning. Furthermore, the learner is 'fitted' into the 'linear' OBE approach and becomes the recipient of assessment, as opposed to being actively involved in or an initiator of the assessment process, and learning outcomes are seen as the products of such a linear process.

Teachers and learners have distinct roles within the formative assessment process (Wiliam, 2014). Formative assessment places the student center stage in the teaching-learning process and how students actually learn becomes a central concept (AfL Reform Group, 2002). Therefore, planning for formative assessment activities involves designing activities that will provide the necessary feedback on learning for both the teacher and the learner, which can be fed back into the teaching-learning process to ensure the *ILS* is achieved. Policy guidelines on 'day-to-day' assessment suggest that teachers are making judgements on their students' learning continually throughout the lesson (Gipps, McCallum, Hargreaves and Pickering, 2005), with the teacher constantly seeking to balance content, assessment and *intended* and *actual* learning outcomes in an environment that is unstable, inconstant and dynamic.

4.9 Planning for learning outcomes

Planning with the purpose, end goal or outcome in mind allows teachers to plan more coherent lessons that focus on essential learning (Hendrickson, 2006; Wiggin and McTighe, 1998). Learning outcomes specify the *intended* endpoint of a period of engagement in specified learning activities and are generally required for assessment purposes (Swaffield, 2008), thus demonstrating the degree of learning achieved by the student (Burton, 2005). Generally, the assessment of a learning outcome is formative, as the learning outcome is a product of day-to-day learning and not a summary of the learning at a particular time; for instance, the end of Key Stage 3. Given this, the learning outcomes of the lesson are closely linked to the ILS since they will demonstrate whether students have achieved the *intended* learning (DfES, 2004b). In many cases, several learning outcomes are produced throughout any given learning journey, providing both the teacher and learner with clear evidence of learning progression in relation to the *ILS*.

Consistent with the behaviourist view on learning, this approach to planning learning outcomes considers that the 'outcome' of a learning experience is a 'product' that is independent and separate from the learner. In this regard, teachers' planning processes often become focused on either the product of learning or the tools for measuring the learning and move away from the education process of learning itself (Hewitt, 2013; Harden, 2002). Waters (2013a) believes increased attention on the end product of learning can alter the nature of the *intended* learning, as teachers design the *intended* outcomes to be 'sweet on the eye' (Waters, 2013a), thus ensuring an *aesthetic appeal* in relation to the product of learning.

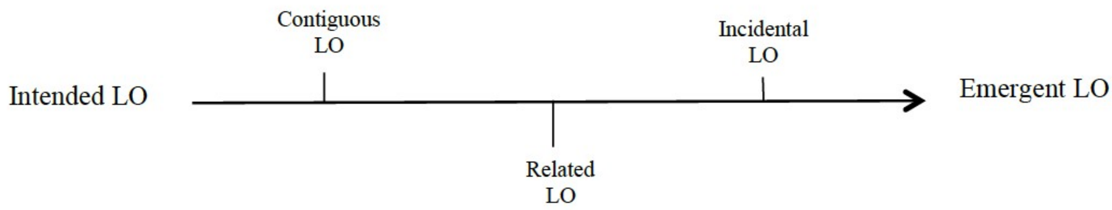
The form the learning outcome takes is generally dictated by the nature of the learning it demonstrates; that is, if the nature of the learning is practical-based, the learning outcome tends to be a practical outcome. Learning outcomes can take a variety of forms, including essays, musical compositions, role-plays, and working prototypes and can be classified in a variety of ways. Drawing on the expertise of the ARG and building on the experience of the TLRP, the Learning Outcomes Thematic Group (James and Brown, 2005) has proposed seven categories of learning outcomes: attainments; understanding; cognitive and creative; using skills; higher-order learning; dispositions; and membership, inclusion and self-worth (James and Brown, 2005). This categorisation of a learning outcome provides an insight into the possible components that a learning outcome may possess; it can be applied to the specification of learning outcomes and to the description of the changes in a student who has achieved a particular learning outcome.

Sadler (1989) makes a distinction between 'permanent' or 'transient' forms of learning outcomes, a concept aligned with the methods of capturing and gathering learning. Permanent learning outcomes exist separate from the learner and can be captured and then gathered and assessed, as or when necessary. In contrast, transient forms of learning outcomes need to be captured and gathered for evidence of learning instantaneously, as such transient forms are temporary and can easily be 'lost'. Such forms of learning outcomes involve students spontaneously providing evidence of learning and require the teacher to able to 'see' the *intended* learning clearly and quickly. In both permanent and transient forms, the teacher needs to consider suitable methods of capturing the learning and then, if necessary, gathering it, for use later. When learning is captured in a classroom, the learning is transformed or captured into a learning outcome. For example, if the *ILS* is 'to be able to use the rubbing in method', the learning is captured in a product that requires the rubbing-in method in its production; likewise, if the ILS states, 'to know the properties and characteristics of aluminium', the learning outcome might be a written report on aluminium which captures the students' knowledge on the properties of aluminium.

The method used to gather the learning may need to be different to the method used to capture the learning; for instance, if the learning has been captured through a presentation to the class and is therefore not tangible or shareable, thus classified as a 'transient' learning outcome, a method of gathering the learning outcome is needed, such as a video of the key learning during the presentation. In this form, the teacher can then assess the learning outcome. Methods of capturing learning outcomes tend to be neglected in the relevant literature, or only briefly included in research on formative assessment procedures. However, the process of capturing and gathering 'produces only a secondary artefact which, while useful in analysis and review, maybe distinctively different in character from the original transient form of learning outcome' (Sadler, 1989: 126).

Megginson's (1994, 1996) notion of 'emergent learning outcomes' is particularly relevant to this research study and is dependent upon the students' involvement in and with the learning. Supporting this notion, Hussey and Smith (2008) claim that neither *ILS* nor learning outcomes can be specifically identified or precisely defined, and suggest that the concept of a 'continuum of learning outcomes' would better support the practicalities of learning. Figure 4.1 sets out a possible range of emergent learning outcomes.

Figure 4.1 'Continuum of emergent learning outcomes' (Hussey and Smith, 2003).



Hussey and Smith (2003: 262) suggest that 'the greater the involvement the greater the possibility of different learning outcomes emerging'. The learning outcomes that are produced by the students range from relatively close to the *intended* learning, termed contiguous learning outcomes', which are considered by the teacher to make a positive contribution towards achievement and to incidental learning outcomes, which may not contribute significantly to the specific subject matter but do so in a general way. By approaching the planning of learning outcomes as a continuum, a more realistic and practical approach to learning is developed, focusing upon the degrees of achievement and not on the pre-specified single learning outcome. Emergent learning outcomes would be flexible and provisional in the sense that various emergent outcomes might be tolerated or encouraged. They would point towards, or indicate in the most general manner, what is to be assessed but not determine it exactly, and they would not be suitable for the close auditing of the teaching and learning process (Hussey and Smith, 2008). Such an approach accommodates modifications to the lesson plan as a result of your formative feedback and 'improvised' planning.

4.10 Summary of Chapter Four

The ability to plan is an essential skill when developing teaching expertise. It entails an approach to teaching similar to that of a problem-solving activity, requiring continual review and modification. As such, teachers need to be conducive to essential alterations in their planning. The dominant planning model is supported by the design of a planning pro forma and provides a prescriptive, standardised planning approach which aligns to an OBE system. Such a linear system approach limits the potential of the teaching-learning process and, in particular, the creativity and flexibility needed to teach Design and Technology effectively. The use of a planning pro forma in aiding classroom practice is questionable, although less dominant within the new pedagogical framework. Several alternative approaches to planning exist that support the requirements of teaching and learning Design and Technology.

Identifying the specific learning that is *intended* to take place during a lesson is not easy, due to the complexities involved in defining what learning is. Whilst the role of the ILS within the teaching-learning process is often confused in terms of function and purpose, it does seem to be an effective starting place for planning, clarifying the purpose of the lesson and providing a clear focus. The formulation of *ILS* often relies on the process of simplification or atomisation of the learning identified in the National Curriculum; as such, the value of the learning statement as a predictor of learning is questionable. Although highly prescriptive, the National Strategy materials did support the writing of *ILS*.

ILS are often written through atomising the required learning in order to enable students to achieve the learning during the duration of the lesson. Teachers are required to demonstrate learning progress, while atomising the learning provides a framework for teachers to be successful. However, developing practical skills in Design and Technology, for instance, often requires numerous applications or extensive practice before a student effectively acquires the skills (McLain, 2013). Hussey and Smith (2008) argue that the atomisation of learning produces *ILS* that are unlikely to be directly measurable by an assessment exercise, as they are often too small or restricted in scope. It is more realistic to suggest that *ILS* used in specific lessons may build towards something that is assessable. In this case, learning outcomes would not necessarily be needed in every lesson.

Atomising the attainment targets into single sets of sentences, which provide the details needed to identify the specific *intended* learning, enables teachers to formulate *ILS* that address the assessment requirements set out in the National Curriculum. The result is an assessment framework that generates and dominates the teaching-learning process, reducing the likelihood of an 'unsuccessful' lesson. However, the attainment targets were originally designed to be used by teachers at the end of the teaching-learning process and not to support the specification of learning required at the beginning (Kimbell and Stables, 2007; Gardner, 2006).

Revealing learning through formative assessment activities is an integral stage of the planning process. Formative feedback is an essential prerequisite within the teaching-learning process and requires careful planning. As such, the learning journey needs to be approached as a dynamic event, responsive to the learning requirements. Learning outcomes reveal learning in a more tangible and accessible form and can be used for both summative and formative purposes. The notion of planning a learning outcome to demonstrate *intended* learning is both operationally and conceptually confused, which current research considers unrealistic, although it is a requirement of the dominant planning model.

Chapter Five presents the research design for this research study, locating it both pedagogically and methodologically. It provides a justification for the chosen methods and development of this study and details the research study design and procedures.

Chapter Five: Research Methodology

This chapter explores suitable research methodologies and research methods, highlighting their limitations and clarifying their presuppositions and consequences in relation to the main research study. The development of the research study is presented together with reference to the pilot study, from initial planning through to the final research study. Chosen data collection methods are discussed and any adjustment made to the method in order to suit the participants, and the goals of the study are fully explained. The main research study procedures are presented in detail and limitations regarding the design and scope of this study addressed.

Due to the complexity of the research design, this chapter is divided into three parts:

Part 1 – Locates the research study in relation to the teaching-learning process and methodological foundations.

Part 2 – Justifies the development of this research study with reference to Part 1.

Part 3 – Presents details on the research study design and procedures.

5.1 Part 1

In order to provide a comprehensive account of this research study, it is necessary to fully address the foundations that underpin it.

5.1.1 Locating this research study within a classroom setting

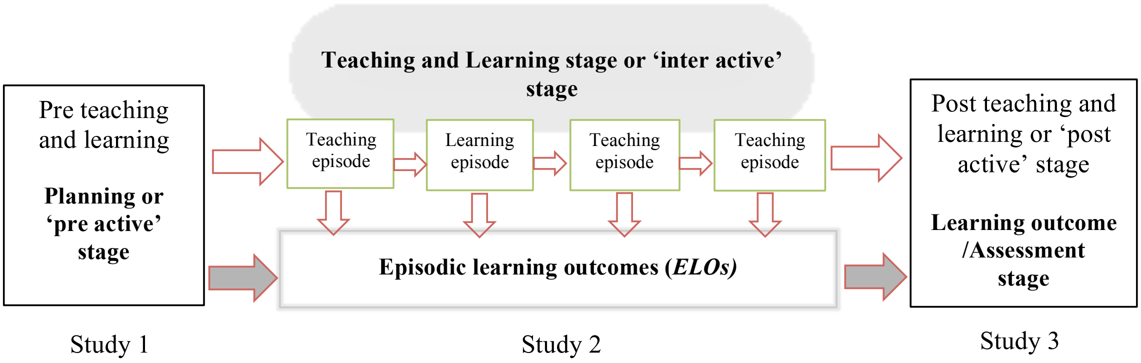
The motivation behind this research study developed from a personal and professional need to develop usable, realistic, manageable advice for Design and Technology teachers on how best to approach the planning process, in order to provide accurate and valid evidence for learning progress. As planning generally initiates the teaching-learning process, this preliminary phase is considered crucial to the effectiveness of teaching and learning in the classroom. 'Educational research, must be centrally, though by no means exclusively, focused on the ways in which learning is encouraged, nurtured, planned and brought about and on the values which are embedded within them' (Pring, 2000: 30). It was essential that the classroom environment and the interface between teaching and learning, with all their complexity, was the focus of this investigation.

Central to this research study is the relationship in procedural terms between the *intended* learning the teacher has planned to occur during a lesson and the *actual* learning that takes place in a classroom environment. With particular focus on the *inputs* to a learning activity, that is, the planning for the teaching-learning process and the *outputs* of a lesson in terms of demonstrating the learning through learning outcomes (see Figure 2.1, p.10), this research study aims to investigate how Design and Technology teachers plan for learning outcomes that can subsequently be used as evidence of learning and assessment activities.

This study examines the planning processes and procedures in relation to the *development or production* of learning outcomes during the lesson, including the methods used by Design and Technology teachers to reveal, gather and capture the learning outcome.

This research study is divided into three distinct stages: Stages 1, 2 and 3. The three-stage model represented in Figure 5.1 below exemplifies a 'systems approach' to teaching and learning, with clear inputs and outputs into the linear system.

Figure 5.1 The teaching-learning process model used in this research study (based upon figure 2.1, p. 10)



The 'pre teaching-learning' stage, Stage 1, involves planning the teaching-learning opportunity, including the *intended* learning and learning outcomes, and is the main focus for this research study. With reference to Jackson (1968) and John (1991), Stage 1 will be referred to as the 'pre active' stage of the teaching-learning process. Stage 2 involves the teaching and learning activities or episodes and are concerned with 'the teacher-student interface', where teachers transform subject content into meaningful understanding by learners (Shulman, 1987: 9), and learners produce learning outcomes that demonstrate their learning. Stage 2 will be referred to as the 'inter active' stage. Stage 3 involves a more 'reflective' approach, with teachers using the learning outcomes produced, captured and gathered from Stage 2 for either formative or summative assessment. This will be termed the 'post active' phase (Clark and Peterson, 1986) throughout this research study.

The teacher-student interactions that are intended to result in *effective* learning are not so much the consequence of a standardised teaching method or procedure, but are, as Pring (2000) argues, 'the result of both teacher and student engaging in meaningful action' (Pring, 2000: 28). Such 'meaningful actions' arise throughout the teaching-learning process. The teacher is constantly adjusting to unforeseen circumstances, responding to levels of understanding and trying new approaches in order to ensure learning progress. The teaching-learning process is inevitably fluid, unpredictable, dynamic, and very complex. Therefore, straightforward causal connections between the teacher's intervention and the learning outcomes are not realistic (Tymms, 1996). The model shown in Figure 5.1 above is not intended to represent either a 'realistic' or 'authentic' teaching-learning process; rather, the 'systems' model simplifies the teaching-learning process in order to allow for greater scrutiny of specific aspects of teaching and learning specifically relevant to this research study. Furthermore, it provides the framework for the overall design of this research study.

This research study will examine the following four sub-research questions, which will subsequently form the focus of the three research studies:

- To what extent does Design and Technology teachers' planning achieves the *intended* learning outcomes,
- To what extent do *intended* learning statement(s) enable *intended* learning to be achieved,
- What methods are used to capture and gather evidence of pupils' learning in Design and Technology,
- Does the evidence of learning captured and gathered in Design and Technology lessons demonstrate the *intended* learning?

5.2 The methodological approach – the interpretative paradigm

This study is based within an interpretative paradigm, characterised by the particular philosophical view that places the intention of understanding on 'the world of human experience' and suggests that 'reality is socially constructed' (Cohen and Manion, 1994: 36). As such, the interpretivist view is that there is no such thing as a 'single reality' of phenomena, but rather 'multiple realities' that can differ across time and place. Interpretive researchers study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings that people bring to them. Consequently, theory has to be emergent and must arise from particular situations (Cohen and Manion, 1994). Interpretivist researchers differ from 'standard' or 'positivist' researchers in their theoretical presuppositions about the nature of schools, teaching, children and classroom life. Unlike 'standard' or 'positivist' researchers, they reject the concept of cause as mechanical, chemical or biological (Erickson, 1986).

An underlying assumption of interpretivism is that the *whole* needs to be examined in order to understand a phenomenon, and understanding the 'bigger picture' is often seen as the strength of an interpretivist approach. This is reinforced by Neill (2006), who advocates that in order to identify problems in an educational system, the whole educational system must be critically examined. Although this research study examines three sequential aspects of the teaching-learning process, as shown in Figure 5.1 (p. 115), the inter-relationship between the various aspects will direct the analysis of the findings.

The notion of 'co-constructing' knowledge between researcher-teacher is central to an interpretative methodology and, consequently, an 'iterative' process, involving the researcher and the participating teachers will form the basis of this research design. In order to retain the integrity of the phenomena being investigated, the researcher will begin with individual teachers and set out to understand their interpretations of the teaching-learning process planned to achieve specific learning.

5.2.1 Qualitative and quantitative approaches to research

There is a danger in educational research, as indeed in everything, of drawing too sharp a contrast between different types of activity or different kinds of enquiry (Niglas, 1999). For many years, qualitative and quantitative approaches have been distinguished on the basis of type of data used: the method of analysis; the approach to explanation; and the basis of the presumed underlying paradigm. Consequently, within much of the current literature, the use of the terms qualitative and quantitative is evident in two distinct discourses – one relating to the research paradigm, the other referring to the research method, highlighted by many as adding to the 'false dualism of education research' (Pring, 2000: 24). In recent years, whilst the qualitative versus quantitative dichotomy has been regarded as artificial and simplistic, many researchers still concede that the epistemological bases and contributions of these paradigms suffer (Bogden and Biklen, 1992; Noblit and Hare, 1988). In effect, the critical epistemological debate in terms of conducting social science research is whether or not the social world can be studied according to the same principles as the natural sciences (Bryman, 2001).

Qualitative research 'is an umbrella concept covering forms of inquiry that help us understand and explain the meaning of social phenomena' (Merriam, 1998: 5). Qualitative researchers are concerned with understanding individuals' perceptions of the world, adopting an exploratory orientation that tries to learn what is taking place in the particular situations and arrive at an understanding of the distinctive orientations of the people concerned. Meyers (2001) argues the depth to which explorations are conducted is seen as a major strength of a qualitative approach, which usually results in sufficient detail necessary to grasp the idiosyncrasies of the situation. In simple terms, qualitative data tends to be represented through words, pictures, or icons and analysed through thematic explorations, whilst quantitative data is represented through numbers and statistics (O'Leary, 2004).

An interpretivist methodology is most likely to rely on qualitative data collection methods and analysis, or on mixed methods. Quantitative data may be utilised in a way that supports or expands upon qualitative data and effectively deepens the description (Mackenzie and Knipe, 2006).

5.2.2 Mixed method approaches to research

Mixed methods research involves both collecting and analysing quantitative and qualitative data, and 'offers both the reliability of counts with the validity of lived experience and perception'. Analysing both types of data allows the two sets of data, and the consequent findings from them, to intertwine and to 'talk to each other' throughout the research study (Datta, 2001: 34), an approach termed *crossover tracks analysis* by Greene (2007). Whilst 'mixing methods may provide more choices, options and approaches to consider' (Wheeldon, 2010: 113) and, greater flexibility than traditional approaches, they generally involve more work and are not always an easy process to engage in (Ertzberger and Kelle, 2003).

Over the past ten years, the field of mixed method research has increasingly been exerting itself as something novel, separate and significant (Torrance, 2012). Tashakkori and Teddie (2003) argue that mixing methods during the research process is a pragmatic way of using the strengths of both qualitative and quantitative approaches. Proponents of the mixed method research approach claim that no single method can afford a complete understanding on the topic under study (Bryman, 1988; Denzin, 1970, 1978), contending that 'the either/or approaches of the past are incomplete and out-dated' (Wheeldon, 2010: 113).

Tashakkori and Teddie (2003) claim that 'mixed method research has evolved to the point where it is a separate methodological orientation with its own worldview, vocabulary and techniques' (Tashakkori and Teddie, 2003: x). However, current literature convincingly disputes the methodological orientation of mixed methods research (see Descombe, 2008; Greene, 2008; Holmes, 2006 for accounts of some of the issues, inconsistencies and variations). For example, Torrance (2012) questions the notion of a separate methodological orientation, with some going so far as to state that 'the claim to a distinct third paradigm is left open' (Torrance, 2012: 2).

The notion of triangulation can be described as the 'core justificatory principle underpinning mixed method approaches' (Torrance, 2012: 3), and is often defined as the use of several methods in one study (Flick, Garms-Homolová, Herrmann, Kuck and Röhnsch, 2012). Since the popularisation of triangulation by Denzin in the 1970s (see Denzin, 1970; 1978), it has tended to be widely misused in relation to both purpose and design. Often used loosely as a synonym for mixed methods, triangulation was originally conceived as the conduct of parallel studies using different methods to achieve the same purpose, with a view to providing corroborating evidence for the conclusions drawn (Okafor, 2013). Triangulation assumes that different perspectives can be generated, providing a richer, fuller, more 'valid' picture of the phenomenon under investigation. Wilson (1986) argues that 'method triangulation', that is data produced by different methods, may be used to provide a basis for triangulation. This presumption, that a multiple data source is superior to a single data source, is firmly located within a positivist methodology (Cox and Hassard, 2005). Certainly, an underlying implication of such research practice is that, by gathering more and better information, accounts can be improved. However, as Patton (1980) suggests, even multiple data sources, particularly qualitative data, do not ensure consistency or replication.

Whilst improving validity (specifically concurrent validity) is often claimed as being the incentive behind triangulation, Morgan (1993) insists that, as each source must be understood on its own terms, triangulation does not actually assist validation. As Hammersley (2005) citing Erzberger and Kelle (2003) points out, the second bearing is not used to check or verify the first bearing; rather, each complements the other in order to identify a particular location. In fact, Denzin (1989) himself abandons the idea of triangulation as a tool of validity, suggesting that its value lies in overcoming personal biases from single methodologies, arguing that 'a goal of multiple triangulation is a fully grounded interpretative research approach. Interpretivist researchers aim to achieve in-depth understanding, first and foremost, and although validity is clearly important it is not the key motivation in any interpretative study (Denzin, 1989).

There are several pertinent issues in relation to triangulation that need addressing in relation to this particular research study. Whilst most reports on mixed methods studies report either parallel or sequential component designs, few studies are a truly integrated design (Torrance, 2012). When using mixed method research, it is important to clarify exactly what, and how, it is being mixed. As Caracellit and Greene (1997) explain, the 'mixing' may be nothing more than a side-by-side or sequential use of different methods, rather than different methods being fully integrated in a single analysis. Torrance (2012) expands on these concerns by insisting any mixed method researcher must examine just how the different kinds of data generated are linked, questioning 'what sorts of integrative thinking processes are being used?' (Torrance, 2012). Similarly, Bergman (2008) questions how researchers link different kinds of data in order to generate a better understanding. In fact, research into how this might actually happen is hard to find. This research study aims to address concerns regarding 'mixing' methods, providing clear description and justification on what and how is being 'mixed' (see Figure 5.3 below, p. 132).

Any qualitative and/or mixed method approach to research design requires interpretations; as a consequence, it is pertinent to ask just whose account of the phenomenon under study should be privileged. Ultimately, the validity always resides in the judgement of an 'expert', which tends to be the researcher (see Thorndike and Thorndike-Christ, 2010, for full discussion). An aspect of triangulation discussed in detail by Torrance (2012) involves 'respondent validation', which engages research participants in responding to initial data or drafts of interpretative reports in order to check them for accuracy, but also the interpretive claims that are being made (Bloor, 1978; Lincoln and Guba, 1985). Mathison (1988) discusses issues with discrepant accounts between data generated from triangulation strategies, arguing that inconsistent data needs to be treated as puzzling findings that inform us that our original understandings may need revisiting or altering. Indeed, further interpretive activity may need to be undertaken to clarify interpretations. However, identifying clear research aims and discussing emergent findings with the participants involved should assist in the production of quality research (Torrance, 2012).

Clearly, a strong methodology will provide a robust framework within which research can be conducted. As such, to explore the complexities involved in the teaching-learning process necessitates either a qualitative or mixed method approach (Hitchcock and Hughes, 1995). As Fraser, Richman, Galinksy and Day (2009) argue, it is not a question of qualitative or quantitative, but 'clarifying exactly which kind of research question is being posed and matching the approach to the data required to answer the question' (Fraser et al., 2009: 19).

5.2.3 Reliability and Validity

A central consideration for any quantitative research involves issues of reliability and validity. However, in relation to qualitative approaches, and particularly to an interpretivist research study, both reliability and validity are problematic and therefore need to be carefully considered in the context of this particular research study. Reliability, the ability to be consistent in order to replicate over time and over groups of respondents, is clearly important to the systematic, empirical, objective investigation of observable phenomena, however as Middleton (2008) argues, the ability to reproduce any qualitative study exactly is low. Whilst Stenbacka, (2001) argues reliability is irrelevant and often misleading in relation to qualitative research, King, Keohane and Verba, (1995) propose that qualitative researchers, in order to produce high quality research, need to strive for replications of their studies. However, 'the most important test of any qualitative study is its quality'

Golafshani (2003: 601), and as such providing understanding of a situation that would otherwise be 'enigmatic or confusing' is the main intention of the qualitative researcher and interpretivist approach (Eisner, 1991: 58). Lincoln and Guba (1985) argue a more relevant term is, 'dependability', which refers to the stability or consistency of the inquiry processes used over time. The research process becomes the focus of attention when checking for dependability, that is, has the researcher been careless or made mistakes in the conceptualisation of the study, the data collection, the interpretation of the findings or the reporting or the results? Reliability within this research study will be addressed through providing detailed descriptions of the settings, procedures, and methodologies, providing the necessary information required when seeking to undertake similar studies. In addition, clear reasoning behind key decisions will be presented and discussed in detail (Denscombe, 2003).

In simple terms, validity is defined as demonstrating that a particular instrument measures what it purports to measure, however, as is evident in the current literature, 'validity is an evolving concept' (Wiliam, 2010: 230), and one that is also problematic in relation to qualitative studies. Lincoln and Guba (1985) contend an alternative concept involves 'trustworthiness', and argue 'trustworthiness' can be thought of as the ways in which qualitative researchers ensure conformability, credibility, transferability and dependability are evident in their research. The concept of transferability and interpretivism and constructivism is complex. Is it possible to transfer and generalise the perceived reality of one individual or treat the account of one individual as representative of a larger sample? This study has attempted to address issues of transferability, that is, the degree to which the results of qualitative research can be generalised or transferred to other contexts or settings. This research study is based in a relatively small geographical location within England and investigates the specifics involved in Design and Technology *intended* and *actual* learning, planned by teachers.

5.2.4 Researcher bias

Gathering data from multiple data sources requires an abductive logic to be applied to the findings. Abductive reasoning allows logical inference to explain an observation or event, that is, inference is the best explanation (Elliott, 1990). However, qualitative researchers must not assign value to one interpretation of meaning without acknowledging the role they themselves play within this construction (Guba and Lincoln, 1989). The researcher is required to study the experiences, influences, and activities of research participants, while explicitly and reflexively acknowledging personal biases, that is, demonstrating a degree of 'interpretive awareness'. Having said this, it is largely impossible to escape the subjective experience when analysing the lesson plans and observing the lessons. 'Observations do not come independent of concepts and theories apart from the prejudices and preferences we bring to the observing' (Pring, 2000: 34). In the conduct of this research, the researcher acknowledged the subjectivity she brought to the research process. In order to address such implications, the research process was designed in such a way to reduce the subjectivity as much as possible by adding two 'validation' checks to the process ensuring alternative interpretations could be aired and providing an iterative relationship between the participants and the researcher.

The researcher taught Design and Technology for ten years and then became an education consultant. During this period, she worked for the QCA as a coordinator for 'The Exemplification of Standards' project, producing national 'standards files' of evidence of learning assessed against the attainment levels (see pp. 1-5). Recently, she undertook Ofsted Inspector training, which provided her with clear guidelines on, experience in, and a framework for 'observing learning'. Her bias stems from a general negativity regarding assessment of learning in practice, the process of levelling and the notion of learning progress currently accepted in secondary schools in England.

5.2.5 Ethical considerations

There is a strong relationship between ethical dilemmas, moral issues and the methods used to obtain data in education and social science research (Fraser, 2007). As this research study involves working directly in schools, with teachers and students, there were particular ethical considerations throughout the research process: in collecting the data; processing and analysing the data; and in the dissemination of the findings. Ethical research in schools can be seen to be based upon three main methods of thinking about what is 'good' research (Alderson, 2010), namely: the principles of respect and justice; rights-based research; and best outcomes-based ethics. All ethical considerations taken into account for the purposes of this research study were made with reference to recognised guidelines of the Economic and Social Research Council (ESRC, 2005) and the British Educational Research Association (BERA, 2004) (see Appendix K). The ethical considerations are discussed in detail below.

The Key Link Teacher (KLT)

Within each of the seven schools, a KLT was appointed. Generally, the KLT was either the Head of the Design and Technology Department or Assistant Head Teacher line managing the Design and Technology department in the school. The researcher was familiar with four of the KLTs in a professional capacity. The KLT was responsible for providing the lesson plans, organising lesson observations and providing the learning outcomes and reduced the involvement of the researcher in the sampling selection process. In all instances, a meeting was arranged in the summer term 2012 to discuss the nature, scope and requirements of this research study.

Throughout the data collection phase, the researcher was very conscious of not having created more work for the KLT and teacher participants, primarily because 'all researchers are dependent on the goodwill and availability of subjects' (Bell and Dale, 1999: 39). When working with teachers, it is useful to keep in mind how busy they are in their day-to-day teaching, and that they are doing a favour for the researcher in being involved in research. Therefore, it is important they know exactly what they will be asked to do, how much time they will be expected to give, and the purpose of the information they provide.

The relationship between the KLT and the participating teachers created a potential issue with bias which was alleviated by the researcher proposing the day and date of the observations, thus reducing the number of possible lessons that could be observed.

Although the KLTs were key to ensuring access to the necessary data and data gathering methods, their role as ‘gatekeepers’ to accessing the teaching-learning process does need further discussion. In all seven instances the KLT was either an indirect or direct line manager of the teacher participating in the research, and thus had access to confidential or ‘sensitive’ information and a level of authority over the participants. This raises several ethical issues regarding the position of the teachers and their participation in the research studies.

In Study 1 lesson plans were obtained directly from the KLT without direct consent from the teacher who had designed and written and had ownership over the document. The KLT identified the lesson plans that would be analysed with no guidance from the researcher, in order to ensure an unbiased, anonymous sample. Teacher consent for the use of the lesson plans would have prolonged the time it took to obtain the data and also identify the lesson plans and therefore it was decided access to this data would be the responsibility of the KLT. In relation to Study 2 there was no guidance given on how to identify lessons to be observed, other than stipulating Key Stage 3 classes. The process of identifying lessons and consequently participating teachers was the responsibility of the KLT, although consent was gained from the teacher once identified. The question of whether teachers would feel comfortable declining to participate in the study when asked by a line manager was considered however it was important that the process of identifying suitable observations was not biased in any way and therefore, although a date for the observations was stipulated by the researcher, the decision on which lesson and teacher to observe was taken by the KLT.

Consent was gained from the Head Teacher and the KLT for each school and from the participating teacher, a few minutes prior to the lesson.

Is it ethical to analyse lesson plans from teacher – yes as they were anonymous by the KLT
Is it ethical to work with teachers that have been identified by their line manager? What position does this put them in? Can they say no?

Student involvement

Teacher judgements on *classroom-based learning* and learning progress inevitably involve inference and bias. Consequently, student involvement in the process of demonstrating, identifying and judging their learning is required. As Smit (2013) argues, students need to be involved in decisions that affect them in their school lives. It was therefore considered important, if not essential to a research study focused upon identifying learning, that students participated in the research. There has been a general shift in social research towards the respectful and inclusive involvement of children in the research process (Flewitt, 2005). Fielding (2001: 135) has offered a useful formulation for considering students' involvement, suggesting 'a four-fold' model: students as sources of data, students as active respondents, students as co-researchers and students as researchers. This research study involved both teachers and students predicting the *ILS* from a set of *ELOs* and in this case, both students and teachers were the data source.

Study 3 provided insights into how students interpret learning outcomes and whether they can 'see' the learning demonstrated. 'Involving children and young people in research is a relatively modern phenomenon that recognises that they have an important contribution to make' (Masson, 2004: 44). Without students' perspectives, the research study would not have produced a complete account of the phenomenon being investigated. However, potential participants were free to decide whether they wished to participate or not, and were informed of their right for non-cooperation and an entitlement to stop at any time or stage during the focus group interviews (see Informed Consent documentation – Appendices F, G and H).

Informed consent

Access to the schools, teachers, and students was approved through written contact. All negotiations and agreements between the researcher and participants clearly defined the purpose of the research, how research approaches were to be used and the *intended* outcome of the research.

Informed consent was required from all participants involved in the three studies, with approval being granted from the University of Roehampton, Ethics Board (see Appendices F, G and H). Study 2 involved observations of lessons and, therefore, an additional letter, to be signed by the Head Teacher, was deemed necessary (see Appendix I). The letter included the following acknowledgment:

'I am aware that the researcher will not be part of the observation process and no data will be collected on any individual child. As a consequence, I acknowledge that parental consent will not be required.'

Although the lesson observations require a degree of student interaction, the teacher was present during the lesson and therefore informed consent was obtained from the Head Teacher, the classroom teacher, the parent/carer and the class members. However Study 3 involved students directly in the research process and required greater consideration. Competent minors less than 16 years old can give consent, with competence being defined as having enough knowledge to understand what is proposed and enough discretion to be able to make a wise decision in light of one's own interests (Alderson and Morrow, 2004). After lengthy discussion with both the classroom teacher and the KLT it was agreed, that in this case, the students could be classified as competent. However, although active consent was gathered from the students, a passive agreement, in the form of a letter was also obtained from their parents/carers (Morrow, 2001; Thomas and O'Kane, 1998). Although formal in design (see Appendix G), these consent letters outlined the student involvement in the research study, why their participation was necessary, how the information would be used and to whom it would be reported. The consent letters were given to the identified students a week in advance to ensure plenty of time to consider participation, thus informed consent was given freely.

Anonymity and confidentiality

Anonymity was strictly maintained for the school, students, and teachers and all data collected, including that through observations and digital photographs, was treated with absolute confidentiality.

The research context was a classroom next door to the student participant's current lesson, which was designated a 'staffroom' for the Design and Technology staff thus provided both privacy and confidentiality (Barker and Weller, 2003) and represented an in-between for the formal and informal worlds of the school (Fargas-Malet, McSherry, Larkin and Robinson, 2010). The right of any participant to withdraw from the research for any or no reason, and at any time, was stipulated at the start of the session, as was the confidential and anonymous treatment of participants' data.

The legal requirements in relation to the storage and use of personal data, as set down by *the Data*

Protection Act (1998)[3] was strictly adhered to and details of storage and use of such data included in the Ethics Application form, provided to the Roehampton University's Ethics Board. The application was granted on 1 July 2012.

5.3 Part 2

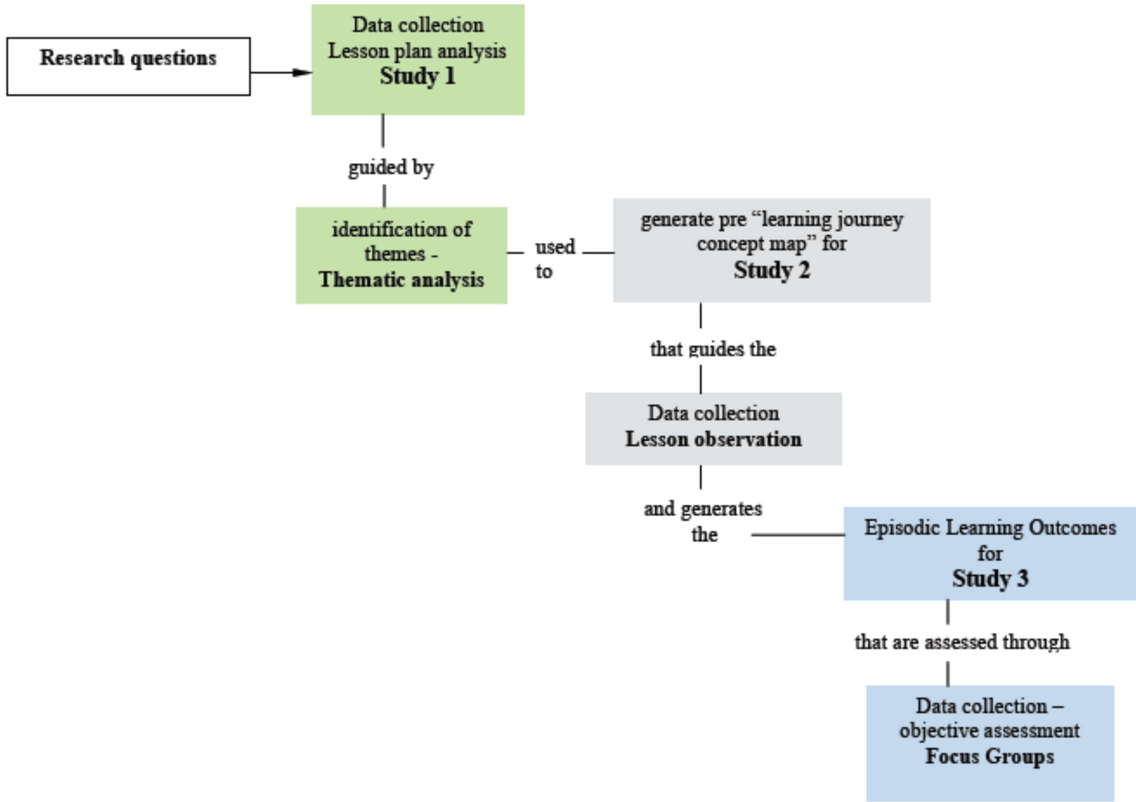
Part 2 of Chapter Five addresses the development of this research study, from initial concept to final design, highlighting issues that needed to be addressed, key influences and modifications made.

5.3.1 Justifying the development of the research study

When investigating such a dynamic and complex process as the teaching-learning process, it is imperative that the research is well-planned, thorough and justifiable in order to withstand public scrutiny. Indeed, this research study required a logical and systematic planning of data collection and analysis in order to allow the influences and relationship between the three stages to emerge (see Figure 5.1, p.115). Figure 5.2 provides an overview for the justification of the overall design of this research study. Each column of colour represents a different study and the relationship between the three studies is made clear. Figure 5.2 presents a logical sequential rationale for the data collection and analysis stages, providing a cohesive summary.

Figure 5.2 Justifying the design of the research process

[3] The Data Protection Act (1998) [online] Available from: http://www.legislation.gov.uk/ukpga/1998/29/contents [Accessed 1 January 2015].



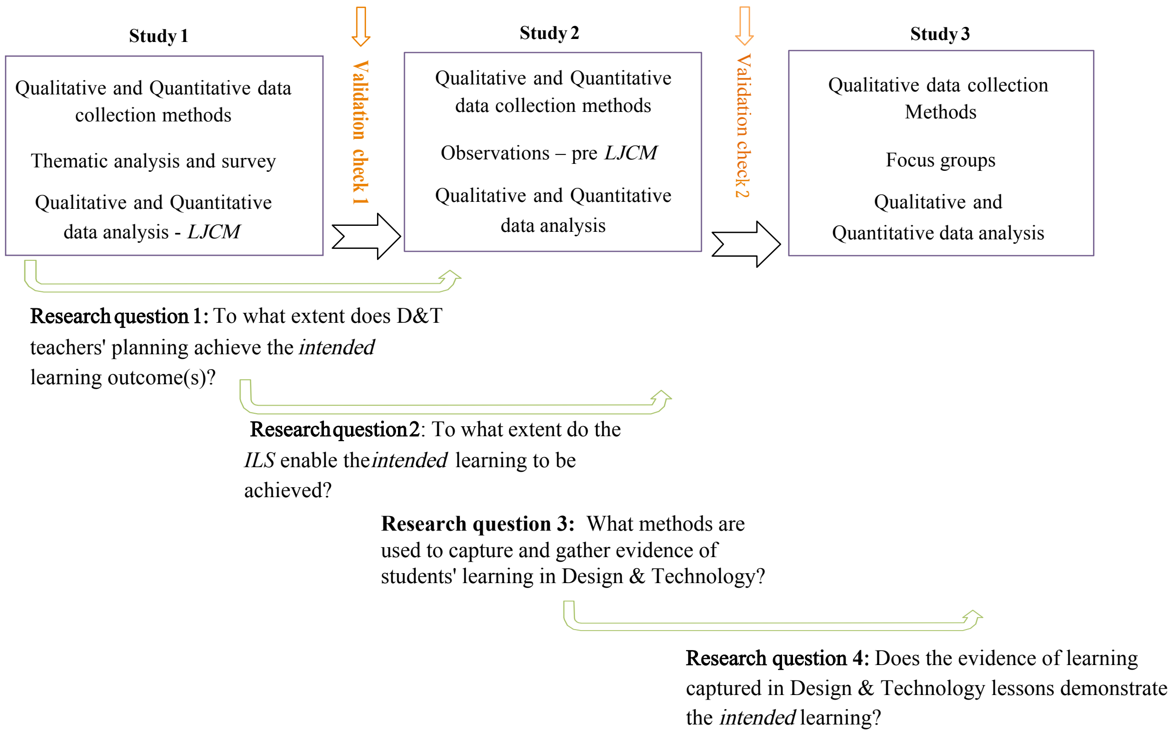
The assumptions underlying this research study are qualitative in nature. Although time-consuming, a qualitative approach provides an in-depth, contextualised, 'natural insight' into planning processes aimed at achieving learning. Qualitative research allows the researcher face-to-face contact with the teachers and learners within their natural setting. Quantitative data, on the other hand, was collected and analysed at appropriate places throughout the study to allow for comparisons to be made between different participating Design and Technology departments.

Neill (2006) describes the three main qualitative methods of data collection as: written descriptions by participants (people asked to write descriptions of their experiences of the phenomenon); observation (descriptive observation of verbal and non-verbal behaviour); and interactive interviewing (people asked to verbally describe their experiences of the phenomenon). This research study used each of these methods to develop a thorough understanding of the phenomenon under investigation.

By choosing to focus on, and seeking to collect and analyse, data from the three distinct and complex phases of the teaching-learning process, isolation of events and therefore decontextualisation was likely to be an issue. Pring (2000) explains that research into 'teaching' often suffers from the same problem as research into learning, namely 'the reduction, for the sake of simplicity, of a complex concept into something that is easily measured' (Pring, 2000: 119). In order to provide meaningful, manageable and effective advice for teachers, investigating the influences on, and the relationship between, the three phases was imperative in the research process design. The data collected and analysed in Study 1 provided the focus for Study 2, and likewise with Studies 2 and 3. All data was compounded chronologically, thus ensuring a cumulative effect.

Figure 5.3 below represents how the three studies relate, both to each other and to the sub-research questions. The light green arrows indicate which study addresses which research question and presents the progressive and culminating design approach. The research methods used for each study show how a mixed method approach is integrated into the overall design.

Figure 5.3 The inter-relationship between the three research studies



In order to address issues of validity, two validation checks were included in the research process. The first check sat between Studies 1 and 2, and involved the KLT being sent the initial draft report generated from Study 1, relative to their school. Asking teachers about the accuracy, fairness and validity of the accounts provides the participants with the opportunity to modify, or add, their views, thus improving the researcher's level of understanding. Given that Study 2 employed observational techniques, validation check 2 was used to review emerging understandings in relation to planning processes and involved discussions with several Design and Technology teachers on the findings to date. It was anticipated that this process would assist clarification of some of the issues, potential conflicts, and suggestions in relation to Study 3. Hopkins (2002) explains, 'involving people knowledgeable about the situation you are enquiring into is a worthwhile activity in itself' (Hopkins, 2002: 136).

Respondent validation (Torrance, 2012) requires the respondent to validate the emerging findings. In

Study 1 the KLT was used as the 'validator' for several reasons. Firstly, the findings had been generalised relative to each school and therefore not specifically related to individual teachers, thus removing the need for direct respondent validation, and secondly, the KLT had the 'overview' of the Design and Technology department and would be able to comment on the 'general' findings from this 'general' perspective. Torrance (2012) argues that respondent validation has not been given enough attention by the mixed methods community and that it should be considered a significant element in the process of democratic participation in research. Indeed, several contributors to the mixed methods literature argue for the development of iterative, self-reflective research practices that align with new forms of 'user engagement' (Thorndike-Christ, 2010; Mertens, 2011).

In relation to Study 3 it is important to be mindful of the potential incongruence between a teacher's publicly declared philosophy or belief about education, evident from how they behave in the classroom, and that teacher's declared goals and objectives for the lesson and the way in which the lesson is actually taught. As Osterman and Kottkamp (1993) explain, there is often a discrepancy between a teacher's account of a lesson and the account of other participants in the classroom. Indeed, Denscombe (2003) points to the manner in which individuals can 'filter' observation by selectively perceiving the situation and selectively recalling the situation.

5.3.2 Analysis of the data from the three studies

The literature reviewed in Chapter two (p.8) highlights a view of learning as a complex entity that is difficult to define and difficult to demonstrate. The design of this research study is relatively complicated in an attempt to address this and involves a range of research tools, analysis methods and research methodologies.

Data collected from Study 1 involved a thematic analysis approach as it was focused upon the 'pre active' stage of the process and would involve planning documents and survey responses. The combination of these two approaches was intended to provide a greater depth of understanding of the teachers' planning processes allowing the researcher to 'make sense' or interpret the processes involved in planning Design and Technology learning. Although individual teachers provided the data, it was hoped a thematic analysis approach would allow themes to emerge from the cohort of teacher responses in Study 1.

The production of the pre and post *LJCM* would allow the themes or main aspects of the planning process identified in Study 1 to be the main focus for the lesson observations, for example the *ILS* and *ELOs*. Clearly being used by teachers in schools (see Chapter Two, p. 30), the use, purpose and value of *ILS* and *ELOs* are central to this research study, particularly how they support the teaching-learning process. From an interpretivist perspective this subjectivity can be viewed as problematic to the integrity of the paradigm however, in relation to Study 2 it was felt this design approach would provide a degree of subjectivity to the observations from the perspective of observer bias.

Chapter Four (pp. 82-110) highlighted confusion in secondary schools surrounding the operationalisation of the learning outcome. This study intends to identify the role of the learning outcome in the classroom. The analysis of the data provided in Study 3 was complex and involved QRS NVivo to provide word frequencies. It was intended that the number of words and their frequency would indicate the 'ease' of identifying the learning from the learning outcomes provided. Study 3 was primarily quantitative in design requiring a group of Design and Technology teachers to provide the data to be analysed.

To summarise and justify the design of this research study:

- Two studies provided the data for each sub-research question;
- Each study was independent and was valid in its own right;
- Studies 1 and 2 had a level of teacher validation;
- All three studies analysed data collected through qualitative and quantitative approaches;
- A mixed method approach was used across all three studies;
- Triangulation was designed into the main research study sequentially; and,
- Data generated by each study was required in another study, providing a clear connection.

5.3.3 Approaches used to research Design and Technology

Internationally, research into Design and Technology education is at an early stage of development. Recently, there has been a collective call from the international Design and Technology research community to consider 'appropriate' research methods when undertaking research into Design and Technology pedagogy (Middleton, 2008; Stable, 2008; Pavlova, 2006). Concerns regarding appropriate research methods focus upon what much of the literature claims is the *uniqueness* of Design and Technology (Kimbell and Perry, 2001; Kimbell, 2007a; Davies, 2000). Middleton (2008) contends that there is a need to provide methods and techniques to capture this uniqueness when undertaking research into Design and Technology education. Indeed, the procedural nature of the subject, the particular characteristics of technological knowledge, along with its diverse roots, demand that new approaches are developed through either adaptations or entirely novel methodologies. Smith and Robbins (1982) argue that researchers need to understand the perspectives and values associated with research methods, draw useful strategies from these, and recognise the ways in which they have been modified and the implications of doing so. What counts for good research will not necessarily match what counts as orthodox methodology (Howe and Eisenhardt, 1990). Thus, throughout the design and development of this research study, the researcher was not constrained by such 'orthodox methodologies'. Within this context, the research methods used in this research study were thoroughly developed and adapted in order to provide the data to address the four sub-research questions.

Interestingly, Harris and Wilson (2004) review the literature on the impact of Design and Technology up to 2002. They contend that it lacks what they term ‘research-based evidence’, and that literature on impact was largely based on ‘small-scale case studies’ drawn from practitioner research which ‘concentrate on narrow areas of research interests’ associated with the context of practice (Harris and Wilson, 2003: v). It remains the case that peer-reviewed academic research has been a relatively insignificant context of literature production in comparison to a context of teaching practice (McGimspey, 2012), an issue this research study attempts to address.

5.4 Justifying the research methods

The following section will justify the research methods used in each of the three studies in relation to the research questions.

5.4.1 Study 1 design

Study 1 aimed to investigate the planning processes and procedures used by Design and Technology teachers when planning lessons, providing insights into the processes teachers employ when designing learning experiences in Design and Technology. It addresses the question:

To what extent does Design and Technology teachers’ planning achieve the *intended* learning outcomes?

Study 1 involved collecting teachers’ written descriptions of their proposed teaching-learning processes in the form of lesson plans. Written before the event, these teaching-learning plans offered a *description* of the predicted event, providing evidence of the *ILS*, how the teacher proposed to structure the learning episodes to achieve the *intended* learning, and how the teacher *intended* to reveal and capture the learning through the learning outcomes.

The lesson plans were analysed using a thematic analysis approach primarily to identify any broad patterns or trends in the data (see Guest, 2012, for extensive discussion on this method). Thematic analysis is not tied to any particular epistemology or discipline and is a process that can be used with many kinds of qualitative data. A degree of flexibility was necessary at this stage as the lessons plans would be different in their form, formatting, overall design and emphasis.

Thematic analysis involves categorising raw data. The categories used in the research study, in the first instance, were identified through consideration of the essential elements required to plan for teaching and learning and then fine-tuned throughout the pilot phase. The categorisation ensured isolation of the key elements of the lesson planning documents that could be further analysed and used to compare against other documents. Boyatzis argues that thematic analysis is a flexible, categorising strategy for qualitative data that provides a way of getting close to the data in order to develop a deeper appreciation of the content (Boyatzis, 1998). As the researcher became more familiar with the documents, additional stages of analysis were added in order to provide a 'deeper' analysis. This deeper analysis provided data on the relationship between the three stages of the teaching-learning process; as a result, and by way of example, examination of the *ILS* became a key focus for Studies 2 and 3. Once the raw data was analysed, the researcher approached Studies 2 and 3 with the key findings in mind. Four main categories (see Figure 5.4) were used to analyse the data provided from Study 1, Part 1, and generated the data needed to address the research questions. By analysing the lesson-planning documents from each of the seven schools, data on the following areas was collected:

Figure 5.4 Description and justification of the four focus areas for analysis

The four main categories	**Additional information recorded**	**Justifying the data collected**
The learning journey	Constructive alignment between the *ILS*, the opportunities for learning and the learning outcomes in the planning phase. The use of Design and Technology key concepts when planning units of work or lessons.	To investigate the relationship between the three elements during the planning phase of the teaching-learning process. To identify influences/frameworks when planning.
ILS	Clear identification of the learning in the *ILS.*	To investigate how the learning is identified.
Proposed teaching strategies	The view of Design and Technology teachers' to learning evident through the planned learning opportunities. Teaching particularly 'challenging concepts' in Design and Technology. The authenticity of the chosen task in relation to the key concepts and *ILS* (Rule, 2006). The pedagogical approach to Design and Technology in terms of 'traditional' or 'integrated'.	To explore the pedagogical approach to Design and Technology.
The learning outcomes	The design of the lesson planning document or proforma in relation to the learning outcomes (Hewitt, 2013). The TLRP (James and Brown, 2005) seven categories of outcomes of learning in relation to the learning outcomes evident in the 47 lesson plans.	To identify methods of capturing and gathering *ELOs.*

The *ILS* category (see Figure 5.4 above) *drives* the planning, the sequencing of learning episode and the formative assessment activities and is used to assess the degree of learning. The *ILS* was analysed in detail in order to provide the necessary data. Recording and analysing the *ILS* allowed examination of the predicted learning and subsequent learning outcomes and is the main focus for Studies 1 and 2.

In relation to the research study itself, clearly the *ILS* can be analysed from both an *intended* and *actual* perspective; that is, during the 'pre active' and 'inter active' phase of the teaching-learning process (see Figure 5.1, p.115). Assuming the *ILS* is clearly formulated, can the teacher translate the identified learning into a learning journey during the 'pre active' phase? And then translate the planned learning journey into successful learning opportunities during the 'inter active' phase? As this research study was primarily located in the 'pre active' phase, the translation of the planned learning journey in the 'inter active' phase was not the main focus of this research, although there were clear opportunities to observe the translation of the *ILS* into a learning journey.

Although a thematic analysis approach was used in this research study, content analysis is another suitable and effective method of analysing documents. Although similar in many ways to thematic analysis, the content analysis categorisation tends to be more specific and clear from the outset (Scott, 1990) and particularly with a qualitative directed content analysis approach. The most frequent criticism of content analysis is that it breaks data into small, decontextualised fragments and then requires the researcher to reassemble them using their own framework (Stemler, 2001). As Kellehear (1993) argues, 'the fetish for frequency makes the technique atomistic' (Kellehear, 1993: 37-38).

Mackenzie and Knipe (2006) provide that, researchers who locate their research within an 'interpretivist/constructivist' paradigm, recognise the impact on the research of their own background and experiences, implying that the data should be structured as little as possible by the researcher's own prior assumptions. Thematic analysis requires a subjective and interpretive approach and 'attempts to overcome outsider's problems of interpretation by staying close to the insider's view of the world' (Kellehear, 1993: 38). In order to ensure a degree of subjectivity, both qualitative and quantitative data was collected and analysed during Study 1.

As a result of the pilot study, it was considered that the use of 'standardised whole school lesson planning documents', in all of the seven participating schools, could affect how individual teachers actually plan their lessons. As a result, these may invalidate the raw data, and so an additional research method and stage was added to Study 1.

A survey can be a relatively cheap and quick way of obtaining information from several schools. The data collected from the survey can then be analysed, patterns extracted and comparisons made (Bell, 2005). Accordingly, a simple survey comprising a single question, which asked, 'how do you plan for your lessons?' was sent to a large number of Design and Technology teachers in order to supplement the data obtained by the thematic analysis. The responses from the survey were collected through face-to-face informal meetings, emails and written responses.

The planned learning outcomes were considered an essential focus for this study, as it is these outcomes that the teacher uses as evidence of the level of learning that has taken place and whether the *intended* teaching-learning process has been effective. The final category involved analysis of the *intended* learning outcomes, designed by the teacher. By analysing the lesson plans, it was hoped that the method of revealing and capturing and/or gathering the learning, ideally for each learning episode, would be established. This category was relatively simple to analyse and was designed to provide data that could be used later in Study 3 as a direct comparison between *planned* and *actual* learning outcomes.

5.4.2 Study 2 design

Study 2 provided a direct comparison between the lesson *intended* to be delivered by the teacher and the *actual* lesson delivered by the teacher. It examined how the learning outcome is produced and how it is captured. With a particular emphasis on formative assessment activities planned and used by the teacher to reveal the learning, Study 2 aimed to answer the following questions:

'To what extend does the *intended* learning statement(s) enable the *intended* learning to be achieved?'

and,

'What methods are used to capture and gather evidence of pupils' learning in Design and Technology?'

Nunan (1989) states that, 'in order to understand what happens when teachers and learners come together, researchers must actually go where the action is' (Nunan, 1989: 76). Study 2 used a series of classroom observations as its main research tool. In respect of the question of how many observations are needed and for how long, Cohen et al. (2001) suggests there is no hard or fast rule, although 'it may be appropriate to stop when "theoretical saturation" has been reached' (Adler and Adler, 1994: 380).

During each observation, the aim was to identify the students' possible *learning* throughout the lesson. It was considered a relatively low inference observation; that is, the lesson observation is focused upon observable facts and events and involves a low degree of subjectivity, requiring the researcher to 'notice' but not to 'judge'. However, 'even low inference observation, is itself highly selective, just as perception is selective' (Cohen et al., 2001: 315). Whilst researcher bias cannot be removed, it is important to acknowledge and lessen its effects. In this regard, field notes were focused entirely on evidence of learning. Whilst the researcher was very aware of the importance of sustaining concentration throughout the lesson observations, it was often easy to be distracted by the students.

An important feature of the observational method, in relation to reliability, is maintaining a consistent approach (Pring, 2000). If this is achieved, observations can provide rich qualitative data, sometimes described as 'thick description' (Geertz, 1973). The use of an 'observation schedule' can be effective and allow the observer to focus only on certain aspects of the lesson, for example the learning episode duration or the method of revealing the learning. The observation schedule took the form of a *LJCM,* produced as part of the thematic analysis in Study 1. The *LJCM* provided a clear structure for the observation and, consequently, a semi-structured observation method was used. Cohen et al. (2001: 305) argues that 'a semi-structured observation can have an agenda of issues and will gather data to illuminate these issues'. Semi-structured observations align neatly with 'interpretive' or 'critical' perspectives, where the focus is on understanding the meanings participants attribute to events and actions in the contexts observed. Through observations, learning can be examined in relation to both the *ILS* and the students' learning during the actual lesson. When the observations are extended to enough cases, generalisations may be made and it was hoped this would be the case in Study 2. Observation data gains in explanatory strength when it is cross-referenced to interview data, artefacts and other kinds of data (Lankshear, 2004: 224). Therefore, data collected during Study 2 was used to supplement the data gathered in Studies 1 and 3.

In order to minimise any influence on either the teacher or the students, the observer assumed a non-participatory role in the classroom; however, students by nature are inquisitive and, as anticipated, some interaction occurred. Whilst Key Stage 3 students are often very familiar with *observers* in the classroom, through increased focus on accountability and standards in relation to teaching and learning (Waters, 2013b), it is important that the researcher was able to both ‘stand back’ and see the *production* of learning outcomes, as well as discuss the learning outcomes with the students if necessary. In some instances, as envisaged by the researcher, the learning outcomes needed to be captured from the students’ classroom books; therefore, it was important that the observer was able to discuss the learning outcomes with the students.

An interpretative methodology requires the phenomena to be observed in its entirety. It is, therefore, argued that the metaphor of a ‘journey’ might profitably be employed to support teachers in understanding the unique and individual interplay of factors in their approach to the processes needed to plan an effective lesson. As far back as Plato, metaphors have been a common means by which to express an understanding of complex concepts. The data collected through observation was translated into a ‘concept map’ termed a *LJCM*. The notion of a *learning journey* in education discourse is commonplace, but mainly used in relation to primary or early years education. The metaphor creates, as Turner explains, ‘an “image schema” of source, path and goal’ (Turner, 1998: 23). Formative assessment aligns to this notion, providing opportunities to assess whether learners are still on the *right path* and providing a focus in terms of a learning outcome to work towards (Gipps, 2005). As Kimbell (2007) suggests, ‘as with any journey, it is critical to know where you are and when you are starting out’ (Kimbell, 2007b: 248). Teachers spend a considerable amount of time trying to assess where their learners are on their learning journey.

Kinchin’s (1998) article on ‘Constructivism in the classroom: mapping your way through’, argues that concept mapping is an effective method of teaching and learning concept ideas. Similarly, Wheeldon (2010) discusses the notion of concept mapping as part of mixed methods research, providing research examples of how different sorts of data can be integrated and combined in novel and potentially useful ways. Patterns are better identified, recognised, and understood through graphic representations of knowledge, experience and perception (Wheeldon and Ahlberg, 2012). Research often draws on pre-existing knowledge and practice to account for current experiences.

Focusing upon Science pedagogy, Abrahams and Millar's (2008) research study presents an interesting comparison to this study. They consider the relationship between what the teacher intended students to learn and what they actually learnt, by observing lessons, and using pre- and post-lesson interviews as their main research tool. Indeed, there are a number of precedents for the use of such an approach to explore, in a critical manner, the relationship between rhetoric and reality within an educational context (see, for example, Ball, 1981; Sharp and Green, 1975).

5.4.3 Study 3 Design

Study 3 was designed to examine, through objective assessment, the validity of Design and Technology learning outcomes, in relation to the *ILS* and to the *actual* learning that takes place. Study 3 focused on the following sub-research questions:

'Does the learning outcomes produced and gathered in Design and Technology lessons exemplify the *intended* learning?'

This final stage in the teaching-learning process is investigated through Study 3, where an inter-subjective view of the learning outcome provided data on the validity of the outcome in order to exemplify the *intended* learning. Such inter subjectivity will allow teachers to bring ideas together in relation to identifying learning. A sample of Design and Technology teachers and students were randomly identified to participate in this study, which used a form of interview technique, namely the focus group. Focus groups consist of a small group of people, usually between six and nine in number. As an interpretivist research technique, this research method places particular value on the interaction within the group as a means of eliciting information and on the collective view, rather than the aggregate view (Denscombe, 1998). In order to avoid influencing the discussion, observers must be outside the vision of the participants, and must not participate (Morgan, 1993). The contrived nature of a focus group, that is, specifically chosen individuals brought together to discuss a given theme, is often seen as both the strength and the weakness of a focus group. The interaction of the members of the focus group was important to this study, as it provided an insight into how *easy* it is to ascertain the learning and learning intention from the learning outcomes.

The students involved in the focus group could be defined as ‘aware subjects’ as opposed to ‘unknowing subjects’ or ‘active participants’ (Alderson, 2010) in as much as, whilst they were asked for their informed, willing consent to being interviewed, this was within a fairly rigid adult-designed project.

5.5 Piloting the research study

Any pilot study principally functions to increase the reliability, validity and practicability of the research tools or instruments (Morrison, 1993) and is considered a crucial element of a good study design (van Teijlingen and Hundley, 2001). Whilst Studies 1 and 2 were piloted allowing pre-testing of the methods and tools, Study 3 was not piloted due to issues with time constraints during the summer term, although a pilot would have been beneficial. As Oppenheim (1992) states, the nature of any pilot study is necessarily exploratory and, as a result, several modifications were required to the design of the main research study. These alterations will be the focus on this section.

The pilot study was conducted during the summer and autumn terms of 2012/13. School A was chosen as the pilot school (see Figure 5.8, p. 155), as the researcher was familiar with the Design and Technology KLT and the school's three-year Key Stage 3 curriculum provided several classes and Design and Technology material areas to work with. A meeting was held with the KLT in October 2012 to explain procedures and requirements involved in the pilot study. Relevant ethical considerations including issues of anonymity and the prerequisite consent forms were also discussed.

5.5.1 Study 1 – pilot

Seven Key Stage 3 Design and Technology lesson plans were sent via email to the researcher for analysis. All lesson plans were referenced and any student identification erased.

Content analysis is a method of analysing written, verbal or visual communication messages (Cole, 1988) aimed at attaining a condensed and broad description of the phenomenon through the generation of concepts or categories (Krippendorff, 1980), and provided the method of analysing the lesson planning documents. The specific approach involved a directed qualitative content analysis (Hsieh and Shannon, 2005), which starts with a theory or in this case, ideas on the initial coding or categorisation.

At this stage in the development of the research methods, the content analysis process involved three distinct stages. Firstly, the lesson plans were read and annotated, with all headings and sub-headings highlighted. During this early stage, the proposed themes or categories were being formulated and it was important that they were kept simple to ensure flexibility (Cavanagh, 1997). This categorisation process required several attempts at re-ordering the clusters of information, thus re-defining the initial categories shown in Figure 5.4 (p. 139). In addition, it was important that the categories clearly aligned to the research questions, particularly to research question 1, 'To what extent does Design and Technology teachers' planning achieve the *intended* learning outcomes?' as

Study 1 was specifically designed to provide data to address this question. The second stage in the process involved transferring the data onto a pro forma (see Appendix Q) and re-ordering the themes. Finally, the data was transferred onto an Excel spreadsheet in order to analysis possible trends and generalisations.

ILS – findings

Teachers were required to identify the learning objectives and the learning outcomes, each of which required differentiation in respect of 2007 National Curriculum attainment levels (Appendix B). The learning objectives were written with sentence 'stems'; for example, 'to understand', often followed by another verb, 'to understand how to use a coping saw', or 'to understand how to demonstrate a set of design ideas using modelling'.

The Learning journey – findings

The main pedagogical *construction* of the lesson plan document involved:

- differentiated learning objectives and differentiated learning outcomes;
- learning activities (with notes on differentiation); and,
- formative questioning (throughout the learning journey).

Teachers from school A used a planning framework based on 'the accelerated learning cycle' to: connect; activate; demonstrate; and consolidate (Smith, 1998) in relation to planning the learning journey. The 2007 National Curriculum Design and Technology key concepts were not evident in the lesson planning.

Teaching strategies – findings

This category aimed to gather details on the learning opportunities designed to deliver the learning outcomes. Skills acquisition and practice-based lessons dominated this category. In five of the lesson plan documents analysed, the learning journey was difficult to identify, lacking a coherent plan and ‘jumping’ from one activity to another. Plenary activities were generally brief and based on ‘what have you learnt?’ type of questions.

The learning outcomes – findings

The learning outcomes tended to be product-focused. All lessons identified one learning outcome per lesson. Typically, learning was revealed through written work and captured and gathered in worksheets and booklets.

The relationship between the *ILS* and the learning outcomes was not ‘clear’ in six of the seven plans analysed.

The researcher did not anticipate the use of whole school lesson planning pro formas before the pilot study. The intention was that the lesson plan could be used as a tool to ‘reveal’ the teachers’ planning process and/or expose ‘clues’ through the design of the plan, relating to how teachers approached the planning for teaching and learning. The standardised format and overall design of the planning pro formas clearly influenced personal planning processes. Furthermore, the planning pro formas only represented a culmination or conclusion of the processes rather than the entire planning process. As a consequence, an additional stage was included into Study 1, which asked the teachers involved in the research the question, ‘how do you plan?’ This was trialled with two teachers during the pilot study.

Removing one of the stages in the content analysis process, by transferring data directly onto an

Excel spreadsheet reduced the time it took to analyse the data.

5.5.2 Study 2 – pilot

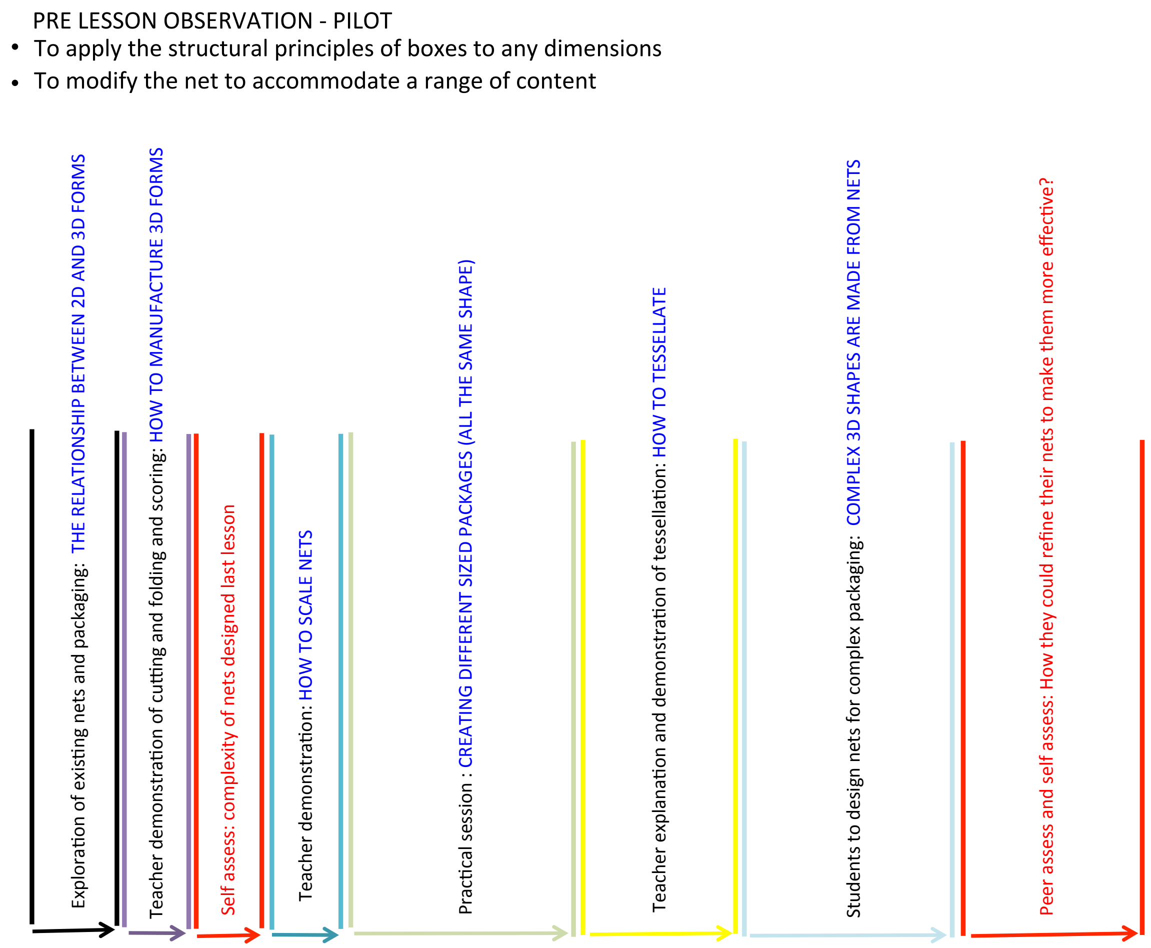
A Design and Technology lesson observation took place in two schools primarily to 'pre-test' or 'try out' the observation schedule in preparation for the research study proper (Polit, Beck and Hungler, 2001). Changes to the main research study were required as a result of piloting Study 2, which are discussed below.

The observation pro forma

The design of an observation schedule for gathering data on the detailed actions that take place in a Design and Technology classroom is crucial to the success of any observational research framework (Stables, 2008). Designed to build upon, as well as substantiate, the data collected in Study 1, the original observation pro forma (see Appendix Y) was significantly adapted throughout pilot Study 2 and after reflecting on the aims of this research study. The final schedule design was inspired by the learning journey metaphor and based on the notion of 'concept mapping'. Metaphors enable the connection of information about a familiar concept to another familiar concept and can, therefore, lead to a new understanding, where the process of comparison between the two concepts acts as a generator for new meaning (Lakoff and Johnson, 1980). The Learning Journey Concept Map (*LJCM*) involved converting the lesson plans into a graphic form by restructuring and isolating relevant aspects and provided a clear view of the themes identified in the thematic analysis in pilot Study 1.

Figure 5.5 presents the results from the first observation of a Design and Technology lesson using the adapted version of the observation pro forma.

Figure 5.5 Pilot Study 2 pre Learning Journey Concept Map (*LJCM*)



The sequence and approximate duration of each learning activity was taken directly from the lesson plan. The red column indicated planned formative assessment activities, whilst the capital blue text was the researcher's attempt at identifying the *intended* learning as a consequence of the planned activities shown in black text.

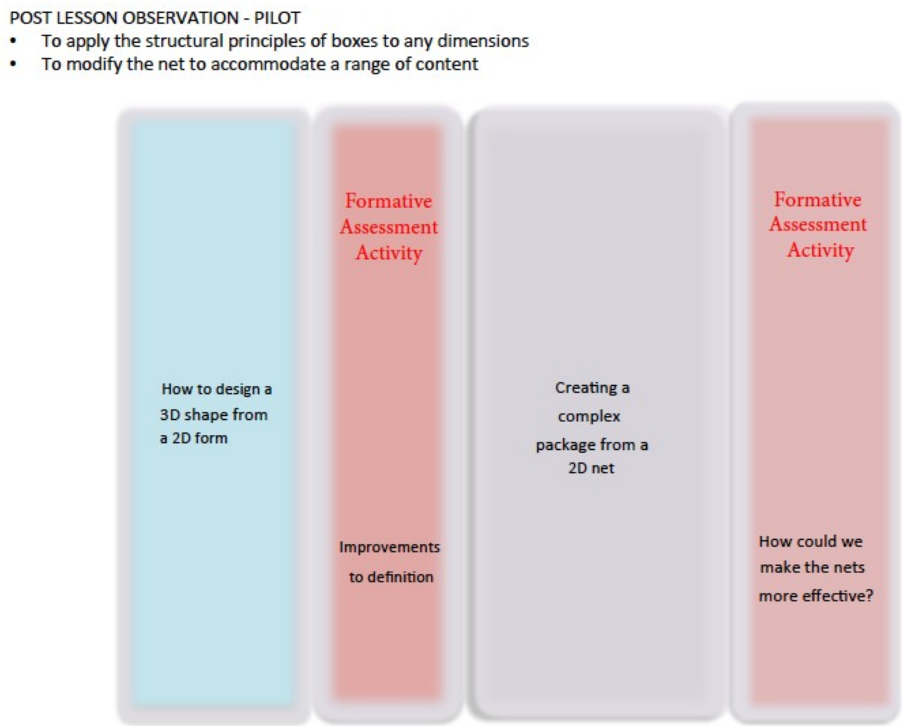
The process of creating a *LJCM* had significant benefits in relation to this research process. Firstly, in order for the learning to be *isolated* from the lesson plan, the learning had to be clearly identifiable. If the learning was unclear in the planning stage, it was presumably unclear in the 'inter active' or 'post active' phase. Secondly, by isolating the *intended* learning from each activity, clues to how the teacher has constructed or designed the lesson are available. Finally, a clearer *view* of the learning represented in the *LJCM* provided visual prompts to key events and allowed the observer to see the 'whole journey'. Field notes became increasingly focused and detailed (Bodgen, 1992), and were scribbled on top of the *LJCMs.*

The production of the post *LJCM*

The production of a post *LJCM* involves digitally gathering the physical outputs from the learning episodes or *ELOs*, such as written work in booklets or products being made by the students. The *ELOs* tended to be gathered during or just after the production, that is during or just after the learning episodes and throughout the lesson. Although such learning outputs do not represent the entire continuum of learning, for example learning that may be demonstrated by questioning sessions, problem-solving activities, or any cognitive forms of learning, they are extremely relevant to the teaching-learning process as they potentially provide the assessment opportunities needed by the teacher to make judgements on student progress, and are often used to support reporting, standardising and moderating processes at Key Stage 3.

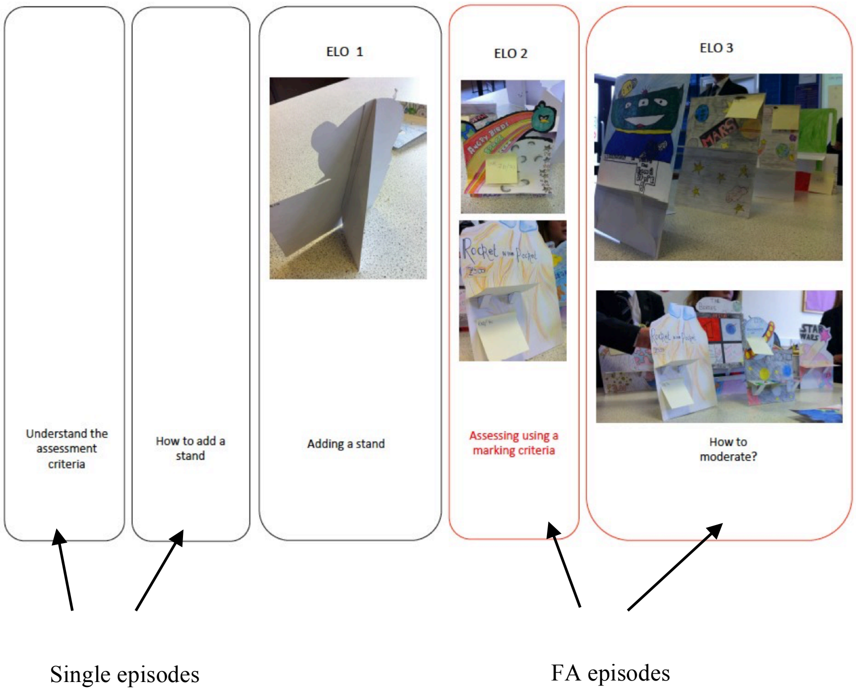
Once the data was collected from the observations, a post *LJCM* could be created highlighting the actual teaching-learning process, including the *ELOs* produced and providing a direct comparison to the pre *LJCM*. Figure 5.6 presents the first attempt at producing a post *LJCM.*

Figure 5.6 Pilot Study 2 post *LJCM*



Whilst the *LJCMs* were used throughout this research study, aspects of their design required improving and clarifying in preparation for the main research study. These aspects related to the ease of producing and reproducing the graphics and ensuring a consistent approach to both the pre and post *LJCM*. The modified post *LJCM* is presented in Figure 5.7.

Figure 5.7 Explanation of the post *LJCM*



The first two episodes did not produce any *ELOs*. The students produced a stand for their display during the third episode. Pairs of students assessed each stand during episode four. The final episode involved a whole class moderation of all the displays (two images were captured)

All the *ELOs* were captured by digital images and referenced directly to the lesson and the relevant episode. The width of each rectangle (above) correlates to the duration of the learning episode. The black text suggests the *intended* learning if it was not made explicit by the teacher. The red rectangles and text refers to a formative assessment activity.

Capturing the learning outcomes

Capturing the learning outcomes was crucial for several reasons, namely for use in Study 3 for identifying the learning, but also as direct comparisons to the *ILS*. The quality of the digital photographs of the learning outcomes needed to be improved in preparation for Study 3, with a higher resolution image required for printing the learning outcomes. The referencing system was trialled and consideration of the chronological order of capturing the learning outcomes, the storage of the digital data and the process of 'backing up' the data was introduced into the research design (Bodgan, 1992).

Once the pilot research was complete and all necessary modifications made, the main study could commence.

5.6 Part 3 - Research procedures

Due to the complexity of this research study and in order to allow for ease of repeatability and clarity of design, the following sections (5.6.1-5.6.5) focuses on the procedures used in this research study.

5.6.1 Background information

The data-collection stage of this research study took place during the summer term 2012 and the summer term 2013:

- Study 1 taking place in the autumn term 2012;
- Study 2 taking place in the spring term 2013; and,
- Study 3 taking place in the summer term 2013.

Figure 5.8 Details on the participating schools

School reference	Category and number of role (nor)	Ethnicity (majority)	% of students eligible for pupil premium	Location description	Ofsted inspection grade
A	Non-maintained **1846** 246 of which are in the sixth form	White British	Average	Semi rural	2- good
B	Non-maintained **1504** 294 of which are in the sixth form	White British	Above average	City center	2- good
C	Maintained **832** 80 of which are in the sixth form	White British	Average	Town center	2- good
D	Maintained	White	Below	Semi rural	2- good

	783 221 of which are in the sixth form	British	average		
E	Comprehensive **1263** 345 of which are in the sixth form	Minority ethic (Indian majority)	Below average	Industrial surroundings	1- outstanding
F	Foundation **1398** 286 of which are in the sixth form	White British	Average	Town center	2- outstanding
G	Non-maintained **809** 104 of which are in the sixth form	White British	Below average	Rural	2 - good

Of the 3,268 state-funded mainstream secondary schools in England, most have between 501–1000 pupils on roll[4].

Seven secondary schools participated in this study and provided a manageable data collection phase for the researcher. Figure 5.8 below provides details pertaining to each school. Such information is important for both contextualising and generalising the findings, in order to be relevant to both a national and international audience.

All the schools were awarded Academy status after the *Academies Act 2010*[5] and all seven schools are located in the Midlands area of England, with six of the schools being familiar to the researcher and all seven schools located in relatively close proximity to the researcher's office.

In one of the schools, a unique 'design' curriculum has been implemented in years 7 and 8. The remaining six schools follow the National Curriculum. However, in School D a middle school

[4] The statistics can be accessed online at: https://www.gov.uk/government/publications/number-of-secondary-schools-and-their-size-in-student-numbers

[5] The Academies Act 2010 can be accessed online at http://www.legislation.gov.uk/resources/framework-for-school-inspection.

education system operates, and therefore only year 9 teaching and learning could be researched.

5.6.2 Sampling and scope

A well-defined sampling strategy that utilises an unbiased and robust frame can provide unbiased and robust results. In this research study, the method of sampling was analogous to that described by Delamont (1992) as 'opportunity' sampling, predominantly using the knowledge and attributes of the researcher to identify a sample. Although often viewed as the weakest form of sample selection and less demanding on researchers in terms of resources and expertise, 'opportunity' sampling tends to place less emphasis on a representative sample. However, in order to generalise the findings from this research study, it was important that the participating schools, and in particular the participating teachers represented the wider population. Furthermore the findings needed to have significant relevance to international contexts. In relation to this research study, the population refers directly to *classroom-based* Design and Technology learning in students aged 11 to 14 years old and as such, comprises teachers of such students.

In order to ensure a representative sample, modifications to a traditional 'opportunity' sampling approach were necessary. In the first instance, introductory letters requesting involvement were sent out to ten schools. As the responses were received, the researcher 'manipulated' the sample through additional phone calls to influence the final cohort of participating schools. As shown in Figure 5.8 above, the participating schools included a range of different types and classification of schools, located in a range of environments and catering for a range of student cohorts. The participating schools were representative of an 'average' secondary school in England, thus inferences could be generalised to the national population.

As this study investigated the relationship between *intended* and *actual* learning and in particular the ‘pre active’ phase, the teachers were the primary focus, and therefore teaching experience of the participating teachers was relevant to the sampling process. Of the seven teachers involved in Study 2, two were in their second year of teaching and although relatively inexperienced, they were *fresh* from teacher training. Four teachers had taught between 5-15 years and one teacher had taught for more than twenty years in the same school. Furthermore, six of the seven teachers had all entered the teaching profession after leaving university. This information was informally gathered from the teachers during the observation visits and was to be used when analysing planning processes. The information aligned to the Department for Education 2010 statistics on teacher age profile[6] (DfE, 2010: 19).

Figure 5.9 below provides information on the samples used for each study. Samples used in Studies 1 and 2 are clearly related, however Study 3 involves teachers from a different sample group entirely. In relation to the data-gathering phase in particular, Study 1 involved six of the seven participating schools, as one school did not respond to the request for lesson plans. Study 2 involved schools A, C, F and G and were chosen as they were the first to reply to the request for a lesson observation. This type of sampling is often termed convenience sampling.

Figure 5.9 Sample data taken relative to each study

Study 1			**Study 2**		**Study 3**	
Study 1.1		Study 1.2				
Participating schools	No. of lesson plans per school	Teachers per school	Participating schools	No. of observations	No. of groups	Teachers per group
A	7	7	A	2	1	2
B	3	1			2	2

[6] DfE data [online] Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/182407/DFE-RR151.pdf [Access on 13 January 2015].

C	10	3	C	2
D	No response	3		
E	10	6		
F	5	6	F	1
G	5	4	G	2
Totals	40 (+ 7 from study 2) = 47	30		7

3	3
4	2
5	2
6	3
7	2
8	2
9	2
10	3
11	2
12	3
Total	27

5.6.3 Study 1 – research methods

Study 1, part 1, involved analysing 40 Design and Technology lesson plans, which was considered to be a 'manageable' number for one researcher to analyse during the first term of the research study. Ten Key Stage 3 lesson plans were requested from each of the seven KLTs in the hope that this would provide the necessary sample. In fact, whilst two schools did not respond to the request for the planning documents during the duration of Study 1, one school did provide three lesson plans, during Study 2, which were subsequently analysed. This was acceptable because, due to the 'nature' of schools, flexibility and cooperation is always required throughout any research process.

Six schools (see Figure 5.8 above) participated in Study 1, part 1, and lesson plans were gathered from years 7, 8, or 9 Design and Technology lessons. A total of 40 lesson plans were sent to the researcher within the requested period, being a response rate of 57%. School D ignored the request and school B only sent three lesson plans. The analysis of the lesson plans took place throughout the period October 2012 to January 2013.

Study 1, part 2, involved emailing each of the KLTs and requesting them to answer the question:

'How do you plan for your lessons?'

The email simply asked for a response, via email, to the question within a week of receiving the email.

One month after the researcher received the lesson plans the first validation phase took place. The draft analysis of the lesson plans was sent to the KLT, together with any comments requested (see Appendix R). Amendments were made to the analysis where necessary.

5.6.4 Study 2 – research methods

Study 2 involved seven lesson observations with seven different teachers of Key Stage 3 lessons during April and May 2013. The lesson plans were requested via an email from the researcher, three days before the lesson observation and analysed using the same procedures (refer to section 5.6.3) as those used in Study 1. A pre *LJCM* was produced for each lesson observation. All participating teachers in Study 2 were asked to fill in a consent form (see Appendix F), as were all participating students in Study 2 (see Appendix G). Although student consent was not needed once the Head Teacher had provided consent for the observations to take place, it was deemed good practice.

During the observation, the duration of each episode was recorded in order to provide quantitative data relating to what percentage of the lesson involved: formative assessment activities; practical activities; teacher demonstrations; and teacher-talking time. In addition, field notes were used to record any particularly relevant events that took place during the lesson and were used to contextualise any distinct findings.

Field notes and comments were also taken in relation to the teaching strategies used, number of learning episodes and the approximate duration of each episode, number of *ELOs* produced, number of formative assessment activities and the percentage of formative assessment activities as a percentage of the whole lesson. In addition, alignment in terms of any lack of correlation between the *ILS*, the learning opportunities and the learning outcomes were noted. All learning outcomes were digitally photographed.

Post observation, a *LJCM* was created that represented a visual representation of the learning outcomes produced during the lesson. This allowed for a direct comparison between the planned learning and the *actual* learning, between different lessons, and between different Design and Technology learning contexts.

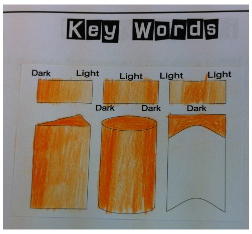
5.6.5 Study 3 – research methods

A student focus group took place during the latter half of the summer term 2013. The group involved four students, two female and two male students. No preference was given to year groups, thus ensuring the greatest flexibility and manageability for the KLT, who was organising the focus group. The research took place in a 'free' classroom near the students' timetabled Design and Technology lesson. The 'briefing sheet' (see Appendix J) was read out to the group by the researcher and any questions raised by the students comprehensively addressed. The procedural instructions for the task were repeated step by step, and the first sets of *ELOs* were presented to the students, in two forms: a laminated A4 handout, and a PowerPoint slide of the *ELOs.* See Figure 5.9 below for an example of a set of *ELOs* used in Study 3.

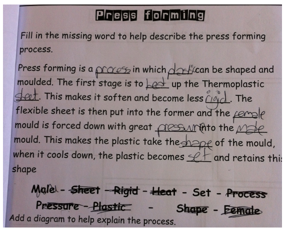
Figure 5.10 An example of one set of *ELOs*

Learning outcome F

1

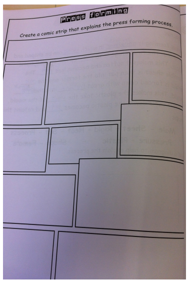


2



3

4



The *ELOs* were collated and presented in order of production, in this case 1-4.

The role and participation of students in Study 3 was carefully considered. As discussed in Chapter 4 (p.82), learning is related to context. The decontextualisation of the *ELOs* and thus the unfamiliarity of the 'learning' context were considered as potentially problematic in relation to the research methods in Study 3. However, it was decided that the students' responses would enhance the findings and provide further understanding to the role of learning outcomes in the teaching-learning process.

The time it took for the group to decide on the *ILS* was recorded in order to provide an indication of the 'ease' of identifying the *ILS* and notes were made on the decision-making processes undertaken by the students. Seven sets of learning outcomes were analysed by the student focus group and the *ILS* suggested for each noted on a given pro forma by the scribe of the group (see Appendix M).

As a result of being asked to present a training session for '*Keynote Education Training'*[7], the researcher was given an opportunity to gather opinions from a greater number of teachers than originally intended and so the structure of the teachers' focus group was refined. Twenty-four Design and Technology teachers attended this training, which was entitled, 'Planning for Learning', and was beneficial as it provided a range of teachers in terms of material specialism, experience and school contexts. The morning session of the training was restructured to include a half an hour session focusing on Study 3. During this session, the research study was explained in detail and consent to participate obtained from all of the teachers (see Appendix F). The teachers were asked to work in pairs or threes, depending on where they were seated. The session followed the same format as with the student focus group.

The teachers' responses to the seven sets of learning outcomes were recorded (see Appendix N) and then analysed by inputting each of the twelve groups' proposed learning intentions relative to each set of *ELOs,* into a qualitative data analysis computer software package called NVivo[8] (produced by QSR International). QSR NVivo (version 9) is designed for qualitative researchers working with unstructured and rich text-based and/or multimedia information, where deep levels of analysis of data are required. The statements were analysed in two ways: word frequency, and the relationship between words. The results were presented in a tag cloud and then compared directly to the original *ILS* relating to the *ELOs*.

The use of a word analysis tool (International NVivo 9) to analyse the results was considered appropriate as it provided an amalgamation of teachers' predictions. However presenting the

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[7] Keynote Educational Ltd is a provider of professional development and student conferences for schools and colleges in the secondary education sector in England.

[8] NVivo is a qualitative data analysis (QDA) computer software package produced by QSR International. It is designed for qualitative researchers working with rich text-based and/or multimedia information, where deep levels of analysis on small or large volumes of data are required.

number of words used to predict the *ILS,* as a tag cloud is a rather atomistic way of presenting data, altering the impression acquired from the raw data.

5.7 Summary of Chapter Five

This chapter provides a detailed account of the research methodology that underpinned this research study and the research methods that were identified as appropriate and effective in order to achieve the overall aims of the research study. All aspects of the research study have been discussed and presented and provide a comprehensive account to satisfy possible replication.

Chapter Six: Results of Studies 1, 2 and 3

Chapter Six provides the findings from Studies 1, 2 and 3 and is presented in three parts. Part 1 focuses upon the 'pre active' phase of the teaching-learning process, Part 2 provides the results from the lesson observations or 'inter active' phase, and Part 3 focuses upon the learning outcomes or 'post active' phase. The results include both quantitative and qualitative data, which are presented using tables and figures to illustrate the responses. Data analysis and key findings are presented in relation to *ILS*, the learning journey, and the *ELOs,* in order to align to the research study as a whole. A summary of the findings will be highlighted at the end of each part and are discussed in further detail in Chapter seven (pp. 222-261).

6.1 Part 1

Primarily Study 1 addressed the research question, 'to what extent does Design and Technology teachers' planning achieve the *intended* learning outcomes?' and focused upon the planning procedures and processes used by teachers in relation to the *ILS*; the *intended* learning journey; and the *intended* learning outcomes. Whilst Part 1 focused upon planning processes and procedures (see Figure 6.1 below), the majority of the data was gathered from lesson plans and therefore findings related to the planning procedures used in schools.

Figure 6.1 Overview of Part 1

The findings from each part are presented separately, followed by a summary generalising the key findings.

6.1.1 Study 1, part 1

The 40 lesson plans collected for Study 1, part 1, plus the seven lesson plans relating to the observations in Study 2, provided 47 plans to analyse. The results are divided into the following areas: the planning pro forma, the learning focus, the learning journey, and, the learning outcomes.

6.1.2 The planning pro forma

All seven participating schools used whole school standardised planning pro formas and required the teacher to provide details on a range of teaching-learning aspects, such as, the content, requirements of the learners, whole school initiatives. The whole school planning pro formas provided a standardised structure within which to plan learning journeys, often leaving little room for the teacher to modify or be creative.

School F used a standardised whole school pro forma that was based upon a structure of, 'teacher input/making sense/reviewing', a constructivist approach to learning. As such, the planning and the learning journey followed a structure that involved a teaching input, followed by a student activity applying the specified learning, and ended with a formative assessment activity. School C used a 'connect, activate, demonstrate, consolidate' approach to planning based upon the Accelerated Learning Cycle (Smith, 1998) (see Appendix E for sample of planning pro formas).

6.1.3 The learning focus

The 47 lesson plans provided 79 *ILS*. The anatomy and clarity of the *ILS* were the focus of the analysis. The relationship between the *ILS* and the Design and Technology key concepts and key processes were also investigated, as the key concepts are intended to provide the fundamental principles underlying the subject, while the key processes provide the essential skills and processes required to progress in Design and Technology (see Appendices B and C).

The anatomy of the *ILS* involved the use of sentence stems with over two thirds (70%) of the *ILS* constructed with the sentence stems, 'to know', 'to be able', or 'to understand'. Figure 6.2 below presents the number of *ILS* constructed using sentence stems.

Figure 6.2 Sentence stems used in the 79 Design and Technology *ILS*

Sentence stem	'To know'	'To understand'	'To be able to'	Alternative sentence stems
Total number	19	16	20	24
Per cent	24	20.2	25.3	30.3

The sentence stem 'to understand…' can be problematic as it does not always define the exact nature of the learning and is not descriptive of the type or level of understanding. Furthermore, it proves difficult to plan for associated evidence of learning based upon understanding.
Nearly a third (30%) of the *ILS* analysed used an alternative sentence stem to the three main stems presented in Figure 6.2. These exceptions included: to create; to produce; to identify; to develop; to use; to discover; to explore; to complete; to demonstrate; to work cooperatively. They were common to two schools in particular (School G and School E), which could indicate a whole school or department approach to constructing and formulating *ILS*.

The clarity of the *ILS* was operationalised at the first stage in the planning process. The whole school planning pro formas required teachers to identify and formulate the *intended* learning into statement(s). On average, there were 1.67 *ILS* per lesson plan, although the pro formas tended to provide space for a maximum of three *ILS*.

The *ILS* clarity classification criteria, adopted by the researcher, involved two distinct aspects: firstly, the identification and then description (being termed as 'the formulation') of the specific learning; and, secondly, the specification of form the learning outcome will take. The classification criteria, when applied to *ILS*, rendered them either 'clear' or 'unclear'. It was deemed important that the classification criteria should be easy to apply, reducing issues with assessor interpretation. Indeed, the criteria was refined and clarified during the pilot phase (see Appendix S).

The process of classifying the *ILS* was not easy, due to the number of *ILS* per lesson plan, their range of focus, and the sentence construction. Several statements were difficult to classify, for example:

'To understand how to reinforce the fabric with card'
'To know how to solder safely'
'To know the 6 Rs of sustainability'

Difficult classifications tended to involve general or ambiguous statements of learning that lacked detail, for example 'To know how to further embellish the card and the fabric to add further design details'. Although it can be presumed that this particular learning outcome will involve some development in the design details of the given product, the exact form the development will take is not stated. In several cases, the researcher had to rely upon her previous experience as a Design and Technology teacher.

In 30 instances (44%), the *ILS* included two verbs, for example 'to understand how to demonstrate a set of design ideas…' or 'to be able to identify…'. These instances confused the classification process in regard to which verb the learning focus referred to. When teaching students 'to understand how to demonstrate', is the emphasis on their understanding or on the students being able to demonstrate? The use of two verbs within the same *ILS* was classified as 'unclear'.

In order to ensure a degree of reliability in relation to classifying the *ILS*, three Design and Technology teachers, in addition to the researcher, were asked to classify the 79 *ILS* independently. Figure 6.3 below provides a compilation of the researchers and the teachers classifications.

Figure 6.3 Classification of the *ILS* in terms of clarity

Schools	**1** **'Clear' *ILS***	**2** **'Unclear' *ILS***
A	8	0
B	11	7
C	2	5
D	8	6
E	3	5
F	7	4
G	11	2
Total	**50**	**29**
Per cent	**63.2**	**36.7**

Almost two thirds (63.2%) of the *ILS* were classified as 'clear' statements of learning. Schools A and G were competent at writing *ILS*, presumably as the result of training in this area.

The Key Stage 3 National Strategy (DfE, 2004c: 6) suggests that *ILS* fit into one of five sets of learning. Figure 6.4 below presents data on the classification of the *ILS* into these five learning sets.

Figure 6.4 Design and Technology *ILS* classified into learning sets

Categories of learning (DfE, 2004c)	
Acquiring and applying knowledge	25
Acquiring concepts	3
Acquiring new behaviours, learning new skills	18
Exploring attitudes and values	0
Personal growth, developing creativity	1

Several *ILS* could not be classified into any of the above learning sets. Exploring attitudes and values was not a focus of any of the learning journeys, indicating the lack of significance of this aspect of Design and Technology education.

The findings showed that 26 of the 79 (33%) *ILS* included the context for the learning; for example, 'to be able to improve the making of your phone sock' or 'to explore the use of aluminium in developing a wind chime'.

6.1.4 The learning journey

This section presents data on the planned learning journey in terms of the structure of the journey and the teaching-learning strategies chosen to provide the learning opportunities required for students to learn.

Each school required a specific and standardised lesson structure, determined by the whole school planning pro forma. The structure of the learning journey generally aligned to the dominant planning approach (Chapter four, pp. 82-110). In other words, locating the lesson within an appropriate context; identifying the learning objectives; structuring the learning episodes into distinct stages or steps, each with a specific outcome; finally, ensuring coherence throughout the lesson episodes from the start to the plenary was promoted by the Key Stage 3 National Strategy (DfES, 2004b).

In the majority of cases, discussing and/or presenting the *ILS* with the students, was the focus of the first activity, evident in 82% of the learning journeys. Dividing the lesson into episodes or discrete activities was evident in all the lesson plans. The number of episodes per lesson varied from four to ten activities per lesson.

A total of 80 teaching-learning strategies were identified in the 47 lesson plans. The learning journeys were dominated by ‘teacher-led’ or ‘teacher-controlled’ activities, such as ‘teacher-talk’ or ‘teacher-led discussions’, with ‘teacher demonstrations’ evident in almost half of the lesson plans analysed. ‘Teacher talk’ generally took the form of an explanation or ‘PowerPoint-led’ teaching episode and was evident as a distinct planned activity in all the 47 lesson plans. Ofsted (2011: 44) reports that, in relation to lessons graded no better than satisfactory, ‘they were dominated by lengthy teacher inputs, with relatively low student involvement’.

Figure 6.5 Teaching-learning strategies used in lesson plans

Teaching strategies	**Identified in lesson plans (n = 47)**
Class / group discussion	21 44%
Learning pairs	16 34%
Practical activities	27 57%
Self directed learning	10 21%
Designing or sketching	14

	29%
Design development	3 6%
Problem solving activities	10 21%
Creative teaching-learning strategies	10 21%
Product analysis	2 4%

Class or group discussions were planned into 44% of the learning journeys; however, it was unclear just how ‘teacher-led’ these activities were. Whole class discussions tend to be a common feature of lessons, yet evidence suggests there is much variation in the quality of ‘talk’ which takes place in terms of facilitating learning (Black, 2006). Most teachers, at some stage in their lessons, used paired activities; that is, activities that involved two students working on the given task. Such paired activities tended to involve discussion on a given question or topic in order to provide a combined and, therefore, considered response. Such activities align to a constructivist approach to teaching and learning, where collaboration and reflection helps students understand their own learning processes.

Over a half of the lesson plans involved a practical learning activity which generally followed a teacher demonstration. As expected, ‘teacher-led’ demonstrations were a common teaching strategy and used by 47% of teachers as the main teaching episode during the lesson. Presumably, the high percentage of practical activities in Design and Technology lessons relate to the fact that teachers are generally good at teaching making skills (Ofsted, 2002), and this may have influenced the choice of teaching strategy when planning a lesson to be observed.

Ten of the 80 teaching strategies were considered by the researcher to involve a creative approach to teaching and/or learning, in as much as they were being used in an original way or were unfamiliar to the researcher. Of the remaining teaching strategies identified, all could be described as ‘typical’ teaching strategies used in the particular Design and Technology context (see Chapter Seven, p. 257 for ‘typical’ teaching and learning).

Formative assessment activities were evident in all the lesson plans and, on average, two activities per lesson plan. Activities included ‘question and answer’ episodes and self or peer assessment activities and were generally included at the start and end of the lesson, presumably to ascertain the whole class learning at the start of the journey and to assess the progression at the end. In the lesson plan, details of the formative assessment activities were minimal, often just stating, ‘review’ or ‘mini white boards’, suggesting that the teachers had experience in these activities and planning details were not required. Indeed, in relation to the planned ‘question and answer’ sessions, there was no information, in advance, on what questions were to be asked. Therefore, it could be assumed that they were ‘improvised’ in relation to the lesson context.

Figure 6.6 summarises data on authentic teaching-learning activities (Rule, 2006) used by Design and Technology teachers. In total, 18 out of 80 of the strategies identified could be classified as promoting authentic learning environments.

Figure 6.6 ‘Authentic’ teaching-learning activities (Rule, 2006)

Four broad themes	**Example**	**No. of teaching-learning strategies (n=80)**
Open-ended inquiry	Problem-solving activities and design development	7%
Thinking skills	-	-
Discourse amongst a community of learners	Debating activities Design considerations – leading to different viewpoints	8%
Self-directed learning	Internet-based research	7%
	TOTAL:	**22%**

6.1.5 The learning outcomes

The form and the number of *ELOs* produced during a lesson was the focus for the analysis of learning outcomes. The researcher identified a total of 33 learning outcomes from the 47 lesson plans analysed. Six plans made no mention of learning outcomes, either as part of the *ILS* or as distinct elements, and in the remaining eight lesson plans it was unclear what the evidence of learning was. In none of the lesson plans did the teachers identify multiple learning outcomes or *ELOs*. Once the researcher had translated the learning journey into a pre *LJCM*, the outcomes of the learning activity could generally be predicted.

Figure 6.7 below shows the results of classifying the *intended ELOs* into James and Brown's (2005) seven categories of learning outcomes. Identification and classification of the learning outcomes was not particularly easy. In a learning outcome involving two different categories, for example 'designing and detailed annotation', a 'best fit' approach was used; in this example, the learning outcome was classified as (3) 'cognitive and creative'. In some cases, the descriptions of the learning outcomes were vague, for example in 'booklet', in this instant the *ELOs* were not classified.

Figure 6.7 Design and Technology *ILS* classified into learning categories (James and Brown, 2005: 10-11)

Categories of learning	**Number of *ELOs* (*n=33*)**
(1) **Attainment**: often based on the school curriculum or on measures of basic competence in the workplace	13 39%
(2) **Understanding**: of ideas, concepts and processes	2 6%
(3) **Cognitive and creative**: imaginative construction of meaning, arts or performance	5 15%
(4) **Using**: how to practice, manipulate, behave, engage in processes or systems	19 57%
(5) **Higher-order learning**: advanced thinking, reasoning, and metacognition	0

(6) **Dispositions**: attitudes, perceptions, motivations	0
(7) **Membership**: inclusion, self-worth: affinity towards or readiness to contribute to the group where learning takes place	0

Predictably, the majority of *ELOs* were classified into either a 'using' or 'attainment' category. 'Knowing that' or declarative knowledge relating to the acquisition of facts, often associated with attainment, was associated with 30% of the learning outcomes gathered. 'Knowing why' was not evident in any of the learning outcomes identified in the *ILS*, although several of the *ILS* that started with 'to understand' attempted to provide opportunities for the students to demonstrate an understanding of 'knowing why'. Although an equal percentage of *ILS* sentence stems started with 'to understand…' the number of *ELOs* relating to this aspect was particularly low, reinforcing the difficulties in planning for learning outcomes that demonstrate this aspect of learning. The number of cognitive and creative *ELOs* was also low for a subject that involves creativity as a key concept.

The methods used to gather the learning took one of three forms, the results of which are presented in Figure 6.8.

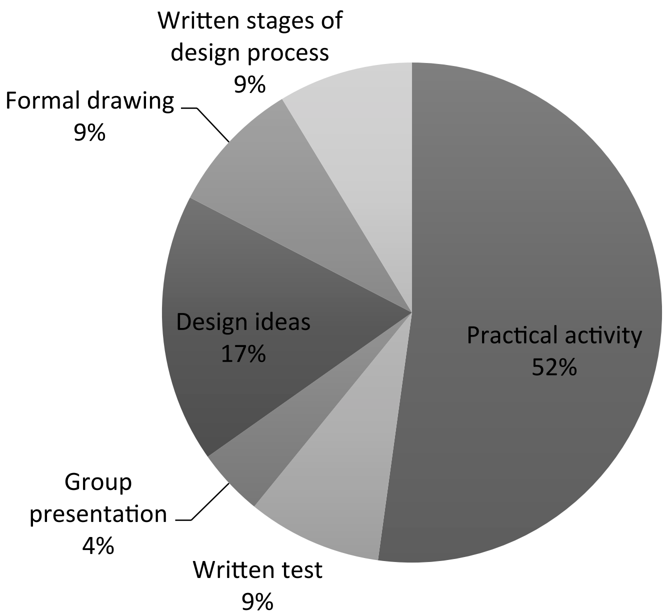
Figure 6.8 Methods used to gather learning outcomes

Form of learning outcome gathered	**Example**	**%**
Practical	Physical products made by the students	46
'Sketched' or 'drawn'	Initial ideas Working drawings	15
Written	Evaluations Product analysis	39

These results support Ofsted's (2002) evidence which suggest that teachers are generally good at teaching making skills.

Methods used to capture learning are presented in Figure 6.9, which shows the 'tangible' learning outcomes identified by the teachers in the lesson plans. Practical outcomes were considered the most appropriate method and support the dominance of practical activities used in Design and Technology learning journeys.

Figure 6.9 Methods used to capture the learning outcomes



Written tests were considered suitable methods of capturing learning in 9% of lessons. As noted above, 'attainment' gained the largest number of learning outcomes (see Figure 6.7 above).

6.1.6 Study 1, part 2

Study 1, part 2, involved asking 30 Design and Technology teachers 'How do you plan for lessons?'. The survey responses were gathered via email and face-to-face interviews. Six of the teachers requested more information before they replied. Email responses were considerably more detailed and reflective (for full transcript see Appendix P).

The particular focus given to answering the survey question varied in the teacher responses.

Teachers tended to emphasis the processes involved in planning, for example, visualising, thinking or making notes but also emphasised the tools or support mechanisms they used when planning, for example, *'I plan in my head'* and then I use the pro forma to *'order my thoughts'* (Teacher F, 2012), suggesting teacher's planning processes involve more stages or phases than filling out a planning pro forma. One teacher stated her planning process involve five clear stages and approximately five days to achieve (Teacher S, 2012).

A third of the teacher's responses suggested some form of collaboration as part of the planning process, for example, Teacher S (2012) stated, *'chat through my ideas with staff in my department'*. Such discussions or 'chats' tended to be informal, involving other colleagues in the department or another teacher and supports the 'collaborative planning' processes promoted in the Key Stage 3 National Strategy materials (DfES, 2004b).

The responses were collated and four main themes identified:

1.'Think about it first (in my head) then go to 'PowerPoint' to formulate it'

'PowerPoint' (PPT) was mentioned in ten of the thirty responses. Teachers tended to use this software as a planning tool, either to sequence their thinking or as a 'creative outlet'. Several responses mentioned the benefits of re-arranging or adding slides providing the 'flexibility' needed when planning for teaching and learning. For instance, one response stated, '*I use PPT as a design tool' – 'I start messing around with the slides'* (teacher D, 2012, Appendix P).

2. 'I think about it and go straight to designing the resources – it is the creative bit I love!'

A sense or apparent need for creative element was a common thread throughout the thirty responses. 'Scribbling', 'mind-mapping', 'sketching' were mentioned as methods used in the planning process. Nine teachers discussed the next stage involved making the resources with two teachers stating that this was the creative stage they enjoyed the most. Six Design and Technology teachers stated that they needed to 'talk it through' with a colleague.

3. 'Think it through – what has to be done step-by-step – where did we get up to last lesson'?

Ten responses indicated a 'doing' focus, for example 'where did we get up to last lesson?', suggesting a practical or procedural approach to planning. One respondent stated, *'I decide what the learning outcome should be, and work backwards'* (teacher D, 2012, Appendix P). A similar response was made by teacher V (2012) who stated, *'[I'll] look at scheme of work – decide what [I] want to do/what next, decide how to do it'*. This approach to planning requires the teacher to visualise the learning journey, step-by-step, and aligns to the use of the sentence stem 'to be able to'.

4. 'I hardly plan, just do what we did last year, unless I am being observed'

There was a distinct category of responses relating to planning being a process Design and Technology teachers do quickly, with nine references to the use of planners to *'jot down some notes'*. Several of the teachers had had the planning process removed from them, for example teacher D states, 'the lesson plan is already written' and teacher Q explains, 'projects are repeated each year'. The reference to 'being observed' was generally mentioned alongside these responses, with teachers stating, '*I only fill lesson plans in when there is a formal observation'* (Teacher C, 2012).

Two teachers discussed issues with ownership of the planning process, misunderstanding what was required from certain aspects of the planning pro forma. Four teachers took the opportunity to explain that lesson plans were 'purely a management tool and requirement'. Interestingly, one teacher felt the pro forma was a ‘quality control’ measure, ensuring he had thought about all the different requirements of a good lesson.

In order to provide a general view, the data was analysed by QRS International NVivo 9 software. The analysis took the form of a word frequency query. The most common words used by the teachers in response to the survey are displayed relative to size in Figure 6.10 below

Figure 6.10 Word frequency tag cloud

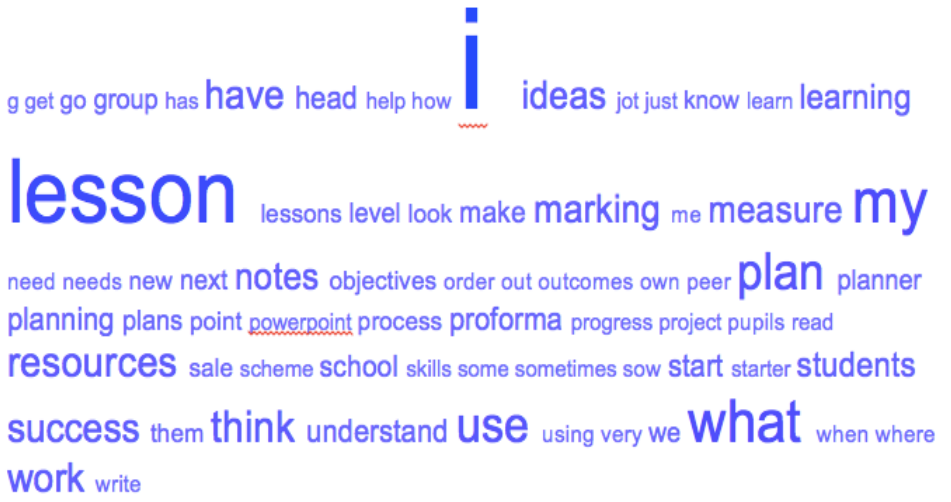


Figure 6.10 suggests that a cognitive process might be the starting point for planning lessons, evident in the prominence of ‘ideas’ and ‘think’. ‘Resources’ is also noticeable. The words ‘criteria’ and ‘assessment’ also appear, suggesting they may have some influence on the process of planning learning.

6.2 Summary of findings from Study 1

Study 1

To what extent does Design & Technology teachers' planning achieve the *ILS?*

Study 1, part 1
Formal planning procedures

- Standardised approach to learning
- Lack of teacher 'ownership'
- KS3 Strategy guided

- Learning focus – National Curriculum-led

Study 1, part 2
Informal planning processes

- Creative, personal approach to learning
- Teacher 'ownership'
- KS3 influenced

- Learning focus – *imagination*-led

⇩

- Episodes used for structuring learning
- Generally *ILS* clearly formulated
- Acquiring and applying knowledge a frequent approach to learning
- Formative assessment opportunities evident
- *ILS* often contextual
- Key concepts are not evident
- 'Teacher-led' activities frequently used
- Learning outcomes not often operationalised in the planning process
- Learning outcomes tend to be either practical or written in form

6.3 Part 2

Part 2 compared the *intended* learning identified by the teachers in their lesson plans against the *actual* learning that occurred in the lesson, as demonstrated in the *ELOs*. It focused upon research questions two and three, 'to what extent do the *ILS* enable the *intended* learning to be achieved?' and 'what methods are used to capture and gather evidence of students' learning in Design and Technology?'. Analysis of the data focused upon the teaching-learning strategies used to provide the learning opportunities necessary to achieve the *intended* learning, and the *ELOs* produced by the students as evidence of learning. Study 2 involved *translating* lesson plans into pre *LJCM*s (Chapter Five, pp.118-165), thus allowing a direct comparison between *intended* and *actual* learning to be made.

This section comprises three parts, which are focused upon three distinct areas of the data:

1. The pre *LJCM*.
2. The post *LJCM*.
3. A comparison between the pre and post data.

6.3.1 The pre *LJCM*

This section presents and describes the pre *LJCM* for each of the seven lesson plans, analysing the *ILS* against the *intended* learning journey.

After analysing the lesson plans (see Study 1, pp.137-142), the researcher made notes on probable learning journeys, which took the form of predictions of what would need to be included in the learning journey. These predictions provided another reference of comparison between *intended* and *actual* learning journeys (see Appendix L for predictions).

Several of the plans presented issues when translated into a pre *LJCM*. These issues included:

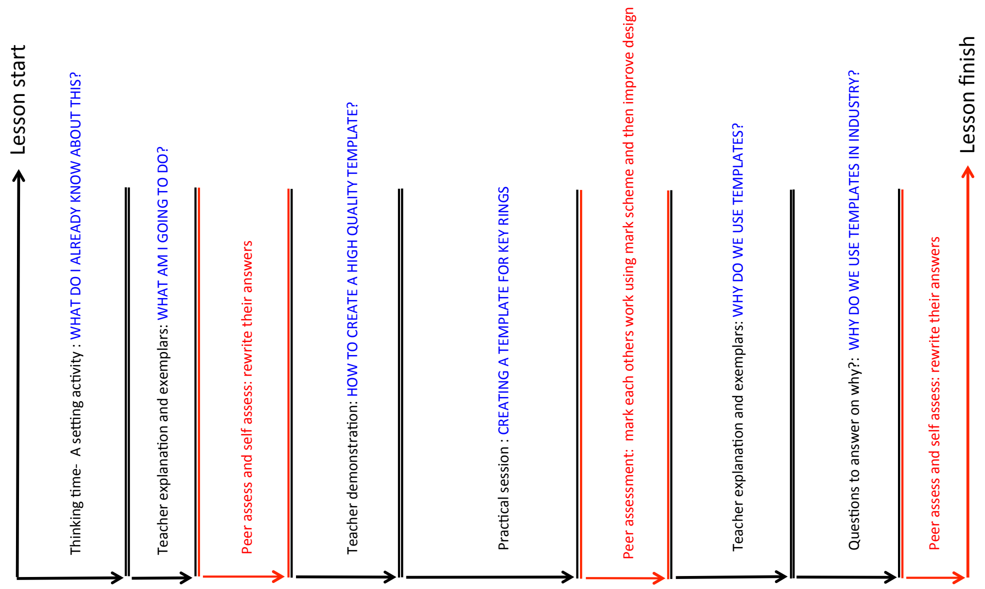
- The teaching and learning episodes did not specify the *intended* learning. For example, one learning activity stated, ‘Students to design a health and safety poster listing up to seven rules’. In such instances, the researcher had to attempt to predict the learning that would take place. However, it proved impossible to predict the *intended* learning in relation to several teaching episodes and, thus, learning was established during the lesson observations, when it could be more easily identified through the activity itself.

- Two or more distinctly different *ILS* presented issues with learning journey focus. In these instances, the researcher found learning progress difficult to identify. Such examples highlighted issues between the relationship of learning activities, assessment tasks and *ILS*.
- Too many episodes planned into the lesson. The researcher was concerned that deep learning would not be achieved in lessons that were so pacey.

The researcher used field notes to provide a short description of the *LJCM* and any additional relevant information was noted. Figures 6.11 through to 6.17 present the pre *LJCM*s.

Figure 6.11 Lesson observation 1: School F Pre *LJCM*

- To know what a template is
- To be able to create a template for their key ring
- To understand why a template is important when manufacturing

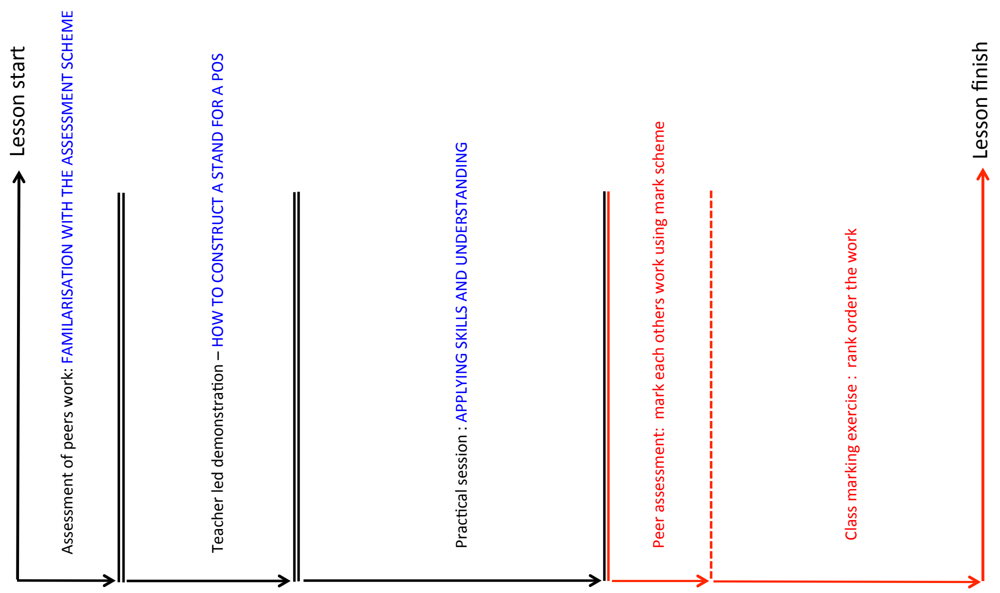


Black text is taken directly from the lesson plan
Blue text refers to the researchers attempt at predicting the learning relative to the activity
Red text refers to formative assessment activities
The length of the arrow is relative to the duration of the intended activity relative to the entire lesson

This learning journey followed a standardised school approach to teaching and learning: 'teacher input' relating to episodes 1 and 2, 'making sense' relating to the practical session, both demonstrating and creating the template and 'reviewing' relating to the formative assessment sessions (see Watkins, 2003). The lesson was 75 minutes long and involved nine episodes, an average of eight minutes per episode, which the researcher felt was potentially problematic. The three *ILS* were to be covered sequentially during the lesson. A concern with this *intended* learning journey arose from consideration of the question 'Why do we use templates?'. This became evident eight episodes into the lesson. The researcher considered the question of understanding why templates are important to manufacturing, needed addressing earlier in order for the students to understand the context of the lesson. There were three opportunities for the teacher to gather information on how students' learning was progressing.

Figure 6.12 Lesson observation 2: School A Pre *LJCM*

- To understand how to use the marking criteria to measure the success of the completed PoS



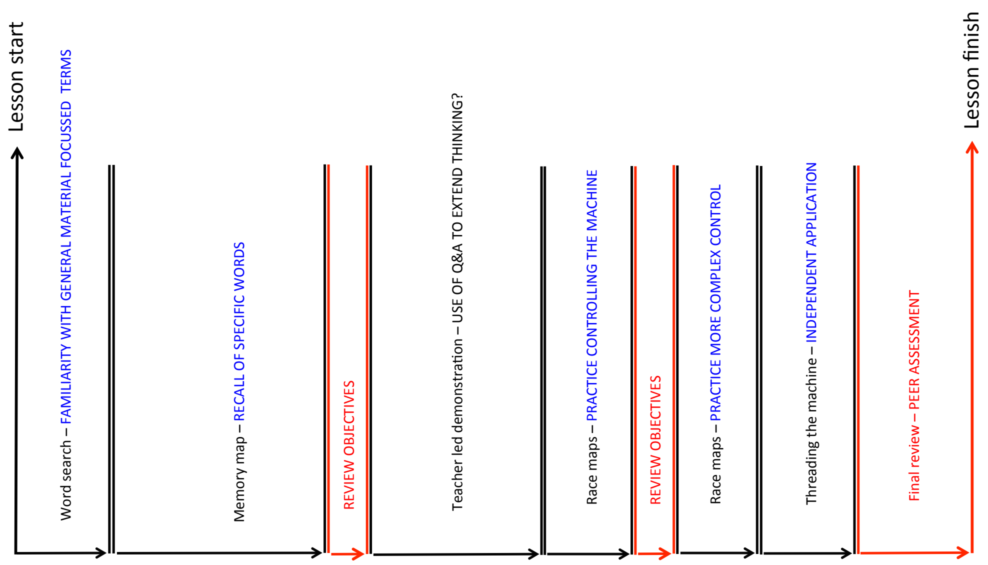
Black text is taken directly from the lesson plan
Blue text refers to the researchers attempt at predicting the learning relative to the activity
Red text refers to formative assessment activities
The length of the arrow is relative to the duration of the intended activity relative to the entire lesson

This lesson was planned to involve two distinct parts: firstly, ‘how to apply a stand to a PoS’ and, secondly, ‘how to apply the marking criteria to the classes’ final products’. The planned learning journey was dislocated and lacked a clear progression route. The majority of the one-hour lesson involved practical work, following a demonstration by the teacher of what was required in terms of the PoS display. However the demonstration did not relate directly to the *ILS*. The researcher considered the practical session lacked challenge and pace and, consequently, was not pitched at the right level. The formative assessment activity involved the whole class, which influenced student engagement. There was no attempt to focus on ‘understanding how to use’; the students were given the marking criteria and told to use it.

Although the *ILS* was classified as clear, the pre *LJCM* clearly shows a disjoint between the *ILS*, the teaching strategies and learning opportunities.

Figure 6.13 Lesson observation 3: School G Pre *LJCM*

- To be able to use the sewing machine safely and effectively

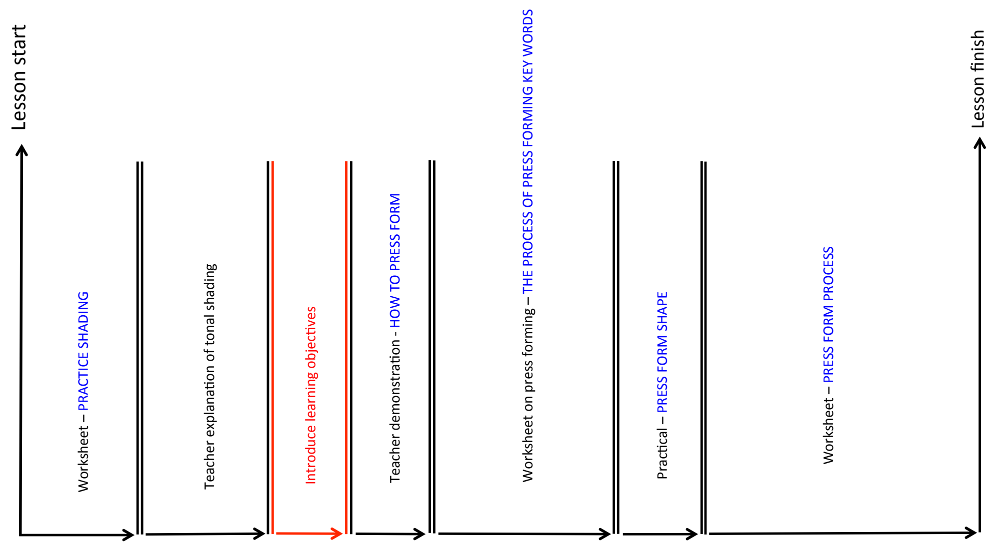


Black text is taken directly from the lesson plan
Blue text refers to the researchers attempt at predicting the learning relative to the activity
Red text refers to formative assessment activities
The length of the arrow is relative to the duration of the intended activity relative to the entire lesson

The planning for this learning journey was clearly structured around ‘building’ the learning, with activities that developed terminology and increased complexity in relation to using a sewing machine. This approach to learning clearly aligns to a behaviourist approach. The one-hour lesson involved nine episodes, an average of 6.6 minutes per episode; potentially this lesson involved too many activities. The lesson provided the opportunity to achieve the *ILS* with learning outcomes that could be used as evidence of learning and involved three opportunities for the teacher and the students to review the learning. The researcher considered several of the activities were original and creative teaching or learning strategies.

Figure 6.14 Lesson observation 4: School G Pre *LJCM*

- To understand what tonal shading is and how to press from plastic

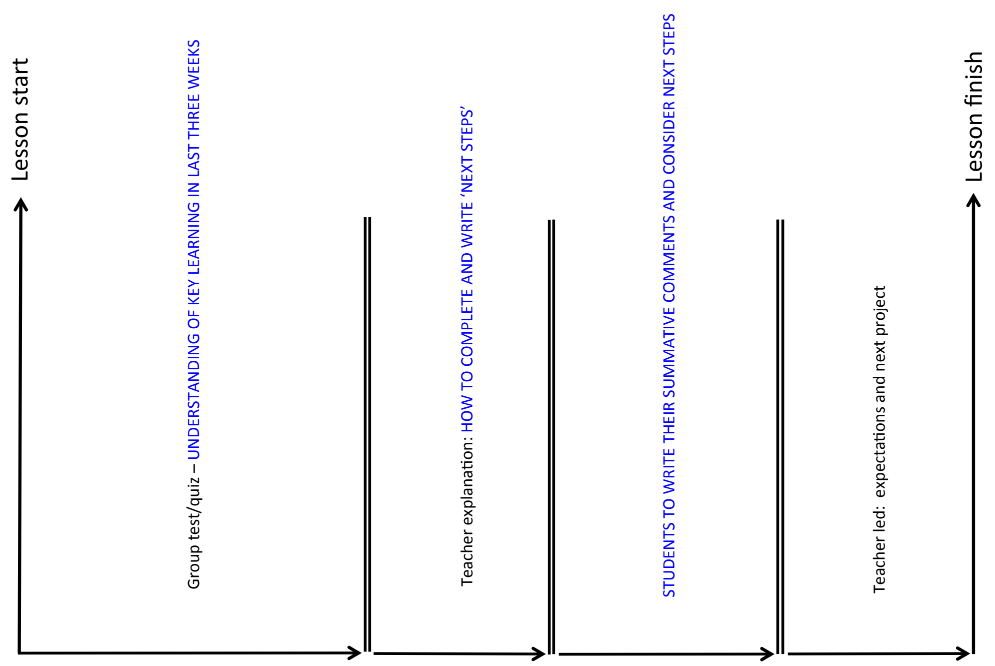


Black text is taken directly from the lesson plan
Blue text refers to the researchers attempt at predicting the learning relative to the activity
Red text refers to formative assessment activities
The length of the arrow is relative to the duration of the intended activity relative to the entire lesson

This lesson involved two distinct parts: learning activities related to shading and tonal scale, and learning activities relating to press forming. Consequently, the pre *LJCM* was difficult to *read* as a learning journey. The practical session on shading involved several worksheets and seemed to be designed to occupy the students, whilst the teacher demonstrated press forming to smaller groups. The *ILS* was achieved in part and the *ELOs* were not identified in the plan.

Figure 6.15 Lesson observation 5: School A Pre *LJCM*

- To review, knowledge, understanding and progress

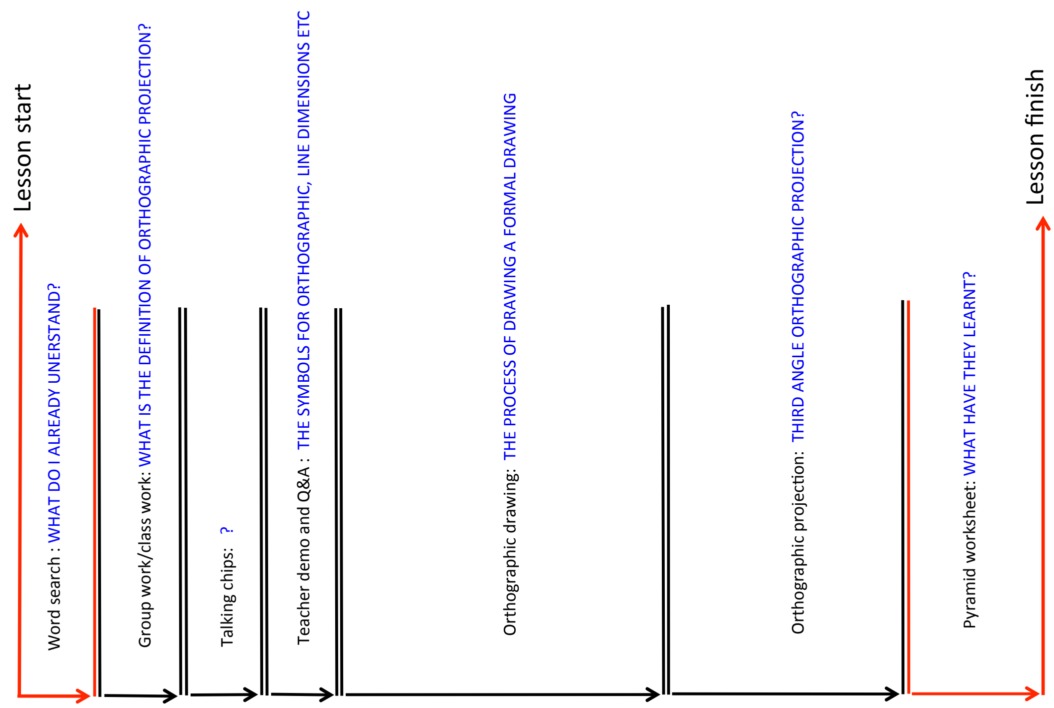


Black text is taken directly from the lesson plan
Blue text refers to the researchers attempt at predicting the learning relative to the activity
Red text refers to formative assessment activities
The length of the arrow is relative to the duration of the intended activity relative to the entire lesson

The researcher considers this type of lesson a 'typical' 'end of module' lesson in Design and Technology, involving students reflecting on their learning. The lesson to lack challenge and pace in plan form, and substantial amount of the lesson was planned to include 'teacher talk'. The four episodes did not allow the students to progress learning and the *ELOs* do not demonstrate the *intended* learning.

Figure 6.16 Lesson observation 6: School C Pre *LJCM*

- To be able to select the correct drawing equipment and produce basic third angle orthographic drawing to a 3mm tolerance

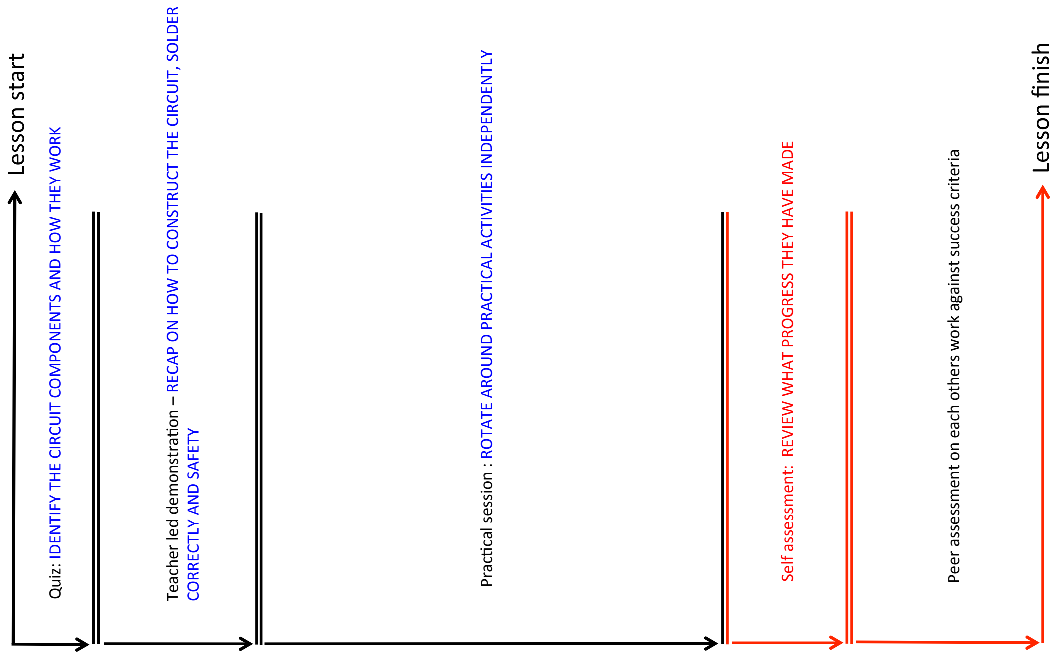


Black text is taken directly from the lesson plan
Blue text refers to the researchers attempt at predicting the learning relative to the activity
Red text refers to formative assessment activities
The length of the arrow is relative to the duration of the intended activity relative to the entire lesson

Orthographic projection is a difficult concept to teach and requires careful planning and practice in relation to effective teaching and learning strategies. Given that a complex task is broken down into smaller tasks and rebuilt, it is a suitable activity for an 'assimilative' or 'cognitive' approach to learning. The researcher considers the *ILS*, that requires students to work to a 3mm tolerance, is unnecessary at this introductory stage of learning orthographic construction. The *ILS* that focuses upon selecting equipment requires an activity based around 'selecting the appropriate equipment', which is not included in the lesson plan. The *ILS* was classified as unclear and the researcher felt that the intended learning journey was too challenging for an introduction to orthographic projection.

Figure 6.17 Lesson observation 7: School C Pre *LJCM*

- To have a clear understanding of how to construct their circuits
- To demonstrate good soldering (safely)
- To identify which activities they will need to carry out to make progress



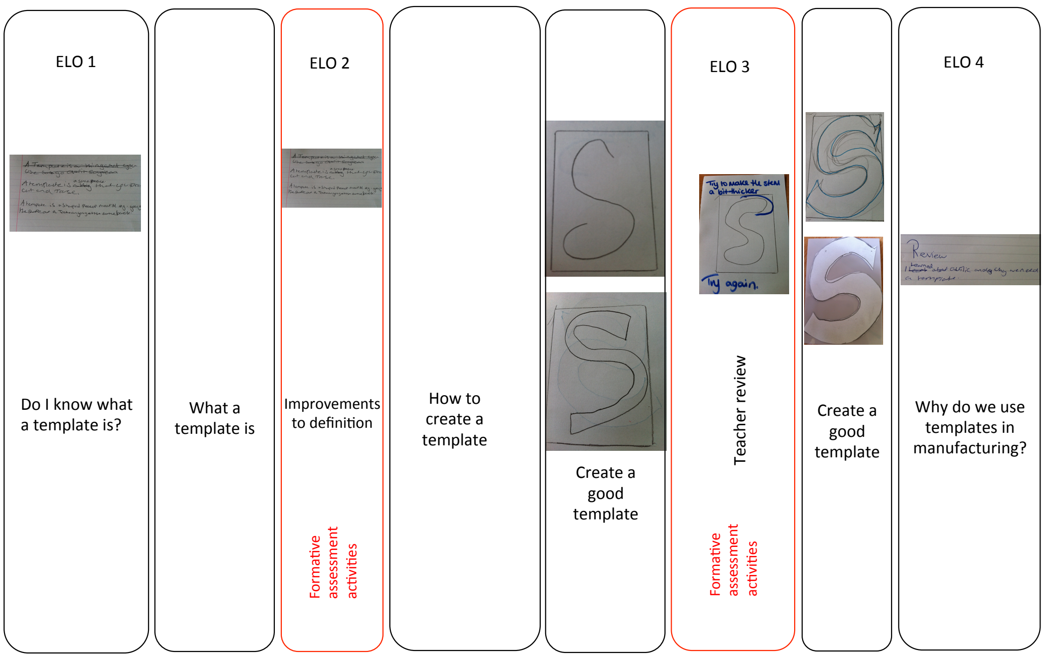
Black text is taken directly from the lesson plan
Blue text refers to the researchers attempt at predicting the learning relative to the activity
Red text refers to formative assessment activities
The length of the arrow is relative to the duration of the intended activity relative to the entire lesson

This lesson was part of a 'half day' Design and Technology learning activity. The observed section of the activity focused upon achieving learning in relation to the final bullet point, 'to identify which activity they will need to carry out to make progress'. In plan, the learning journey was difficult to understand. The students had the opportunity to demonstrate the learning in a long, practical session. The lesson plan did involve both self and peer assessment activities, planned as the plenary of the lesson. There was no opportunity for the students to test their circuits.

6.3.2 The post *LJCM*

This section presents the lesson observations through post *LJCM* (see Figures 6.18-6.24). Time duration for each episode relative to the entire lesson, the number of episodes and *ELOs* were the focus of the analysis. The black text in each of the post *LJCM* refers to the 'suggested' learning during each episode, noted by the observer during the lesson observation. Field notes were taken during the observation in order to explore issues that arose.

Figure 6.18 School F Post *LJCM*



ILS:

To know what a template is .... 'Unclear'

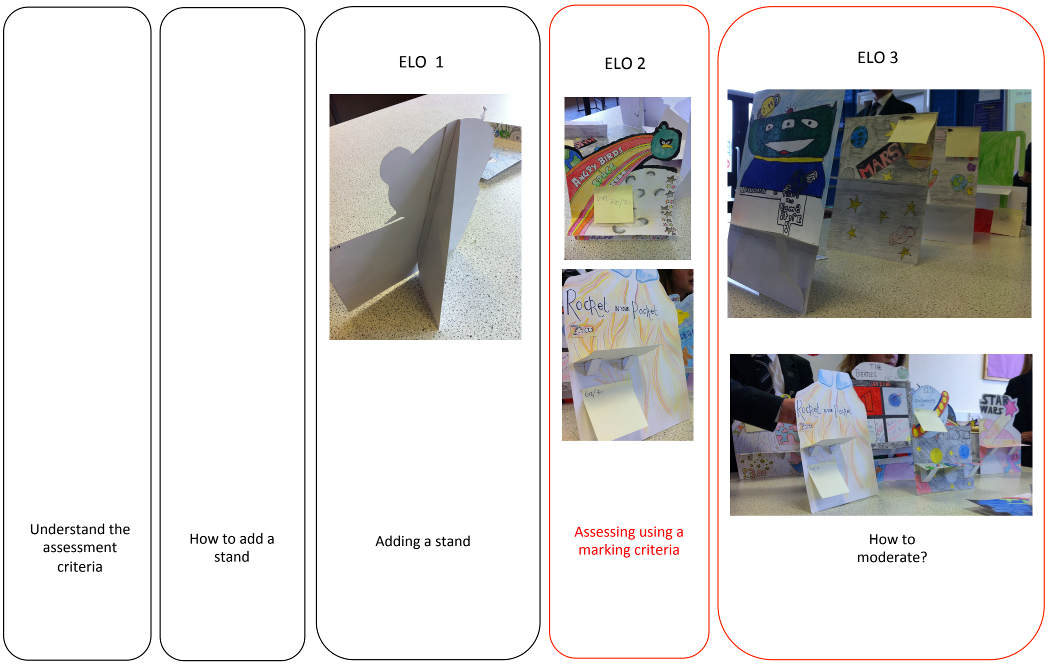
To be able to create a template for their key ring .... 'Clear'

To understand why a template is important in manufacturing .... 'Unclear'

Intended learning outcome: Template for a key ring – a practical outcome

The lesson was aimed at low-ability SEN students in year 9 who found it challenging to listen for several minutes and to write answers to questions. The researcher considered the lesson to be good, with the majority of the class on task for the majority of the 80-minute duration. The use of eight episodes provided pace, which supported the students' learning, although the formative assessment activities tended to disturb the learning progress (TLRP, 2009). Episodes 2 and 4 involved 'teacher talk' or 'demonstration' and neither activity were clear in terms of specific knowledge and understanding. The templates were produced in paper and then stuck onto the acrylic, which clearly does not fulfil the requirements of a template in relation to replication and repeatability. The peer assessment activity (episode 6) transformed into a teacher review activity, primarily because the students were unable to constructively comment on each other's templates. Although formative assessment activities were well planned within the learning journey, they tended to create a disruption to the learning activity; particularly given that the teacher did not respond to the available feedback. At the end of the lesson, the students found it difficult to describe what a template was and why they are used during manufacturing. The learning that was demonstrated did not lead to the final outcomes addressing the *ILS*. The students learnt how to make a template, but it was not clear from the *ELOs* that they understood why they were being asked to make a template.

Figure 6.19 School A Post *LJCM*



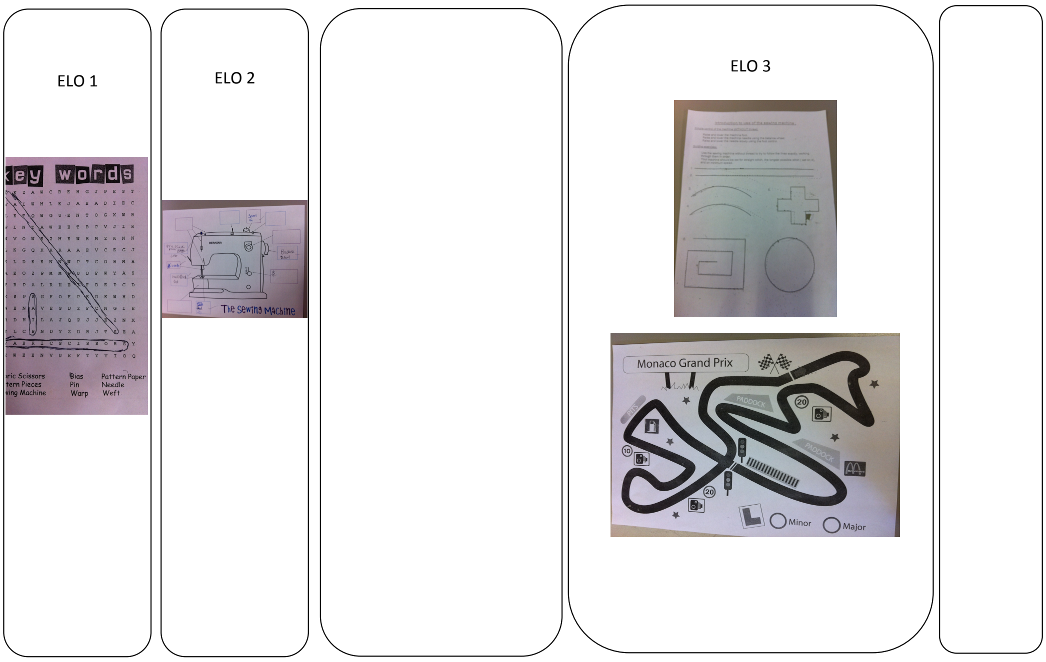
ILS:

To understand how to use the marking criteria to measure the success of the PoS ...... ‘Unclear’

Intended learning outcome: Not specified

The lesson involved two distinct parts: adding the stand to the PoS display, and assessing the product. The specific learning was difficult to identify. The formative assessment activities lasted 26 minutes of a one-hour lesson and failed to engage the whole group for the duration of the activity. The *ELOs* do not indicate that the class knew how to use the marking criteria. Although the ‘marking or assessing’ was in written form on a ‘post-it’ note, the method of capturing this written form and gathering it was not considered. The lesson plans did not distinguish between methods of capturing the learning and gathering the learning.

Figure 6.20 School G Post *LJCM*



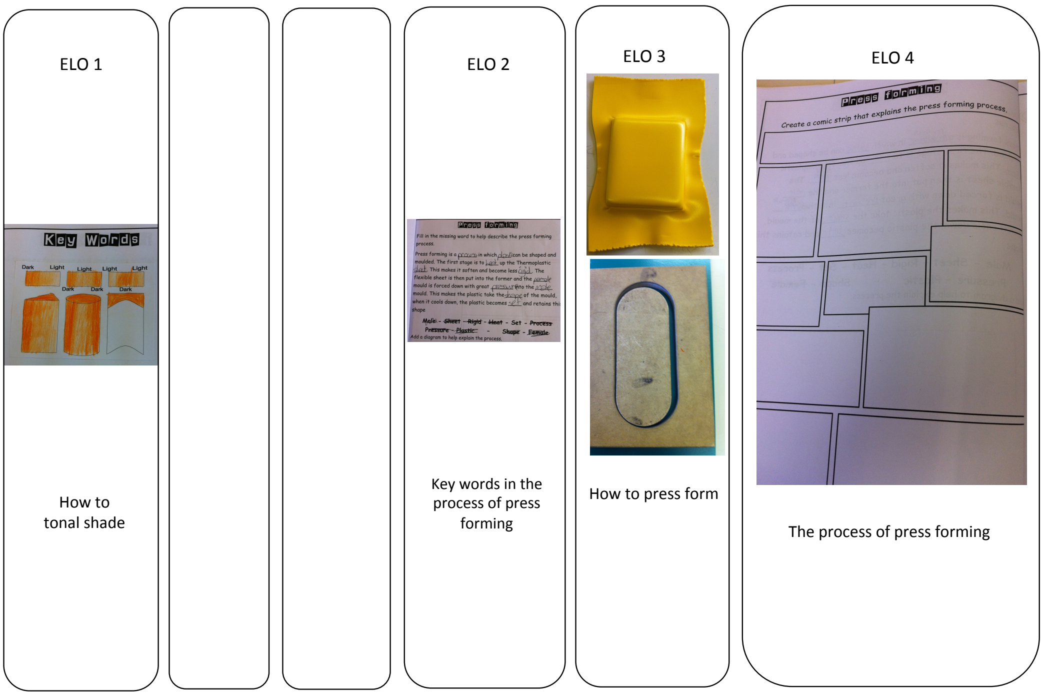
ILS:

To be able to use the sewing machine safely and effectively....................................... 'Clear'

Intended learning outcome: Not specified

The researcher learning progress appeared to be good, involving several creative teaching-learning strategies. The three *ELOs* produced during the lesson clearly provided evidence that the students could use the sewing machines safely and effectively. The lesson was designed to progress the learning from a basic level to a more advanced level, and this was evident in the *ELOs*. Although the formative assessment episodes did not take place, the students were clearly learning and this may have been a deliberate decision on the part of the teacher not to disrupt the learning environment.

Figure 6.21 School G Post *LJCM*



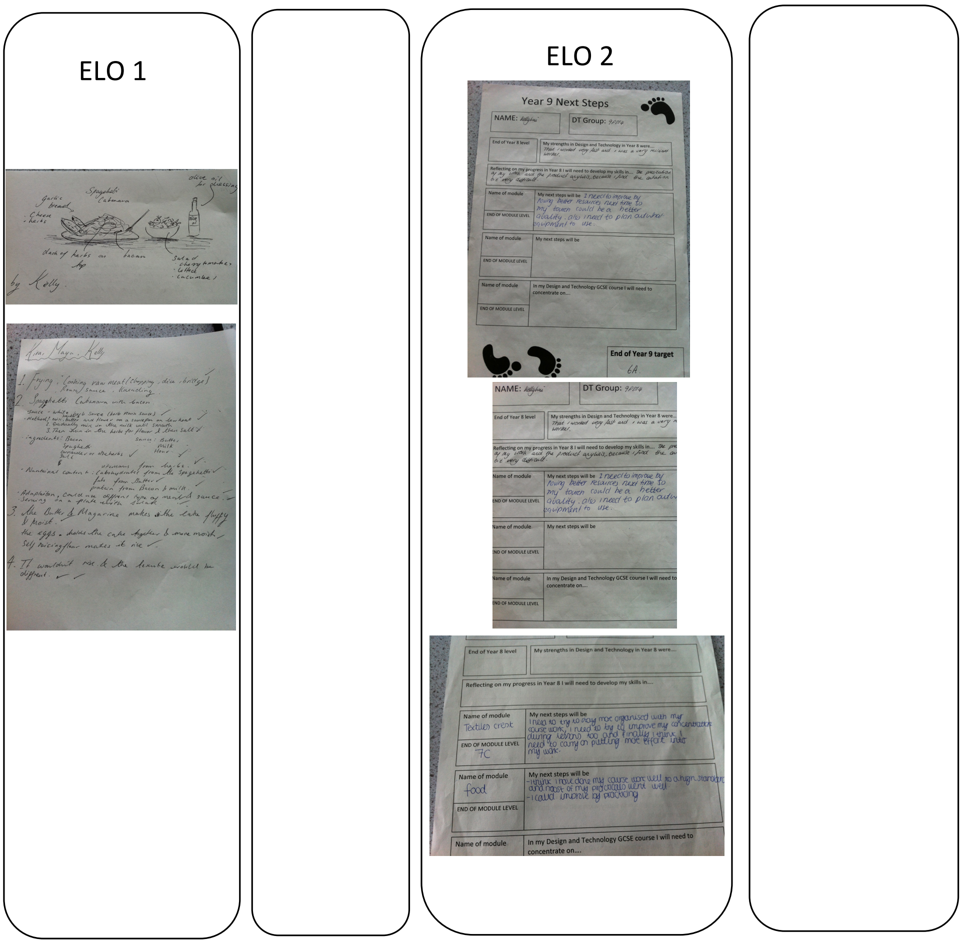
ILS:

To understand what tonal shading is and how to press from plastic .... 'Unclear'

Intended learning outcome: Not specified

This hour-long lesson involved two distinct parts: how to shade and how to press form. The learning progression was difficult to identify by the researcher. Three of the six episodes were based around the use of worksheets, which became the associated *ELO*. The press forming activity was good, focusing upon the key words, the use of the press forming machine and a written activity describing the process. *ELOs* 2, 3 and 4 provide evidence of learning about press forming.

Figure 6.22 School A Post *LJCM*



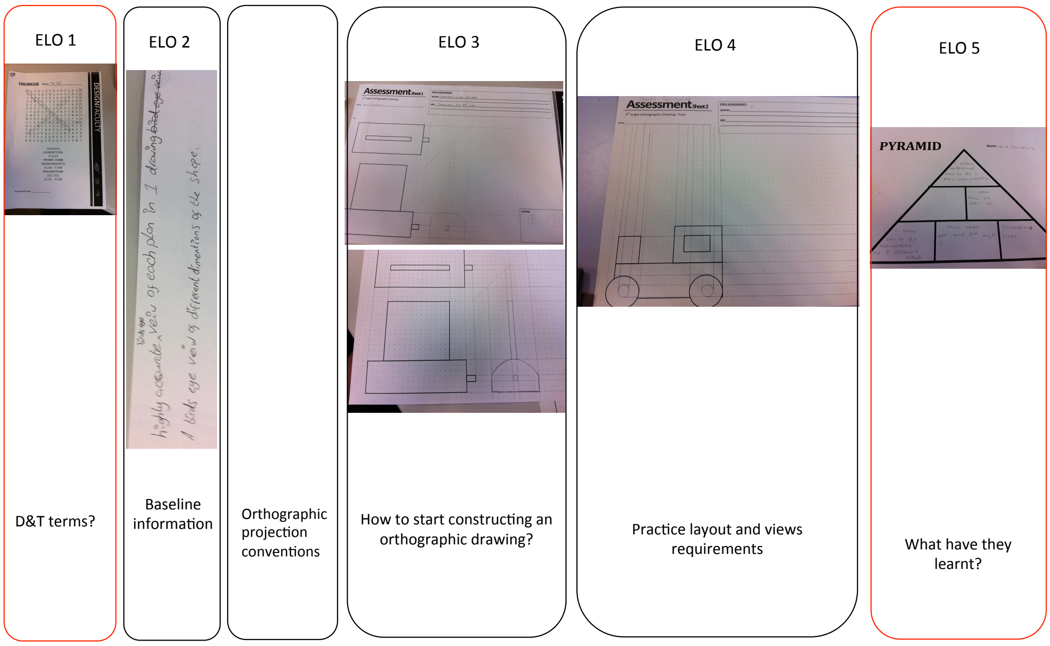
ILS:

To review knowledge, understanding and progress .... 'Unclear'

Intended learning outcome: Not specified

The lesson involved a written 'quiz' for the first 25 minutes of an hour-long lesson, an explanation from the teacher on how to fill in the 'end of module' pro forma, followed by the students filling it in. The researcher considered the learning that took place during the lesson to be minimal and student reflections were generally tokenistic, with no evidence of meaningful target setting; for example, 'I need to improve by getting better resources next time'. The material focus for this module was food; however, as the group was moving onto resistant materials, the target setting exercise needed more teaching input in order to be relevant to the learning required in Design and Technology.

Figure 6.23 School C Post *LJCM*



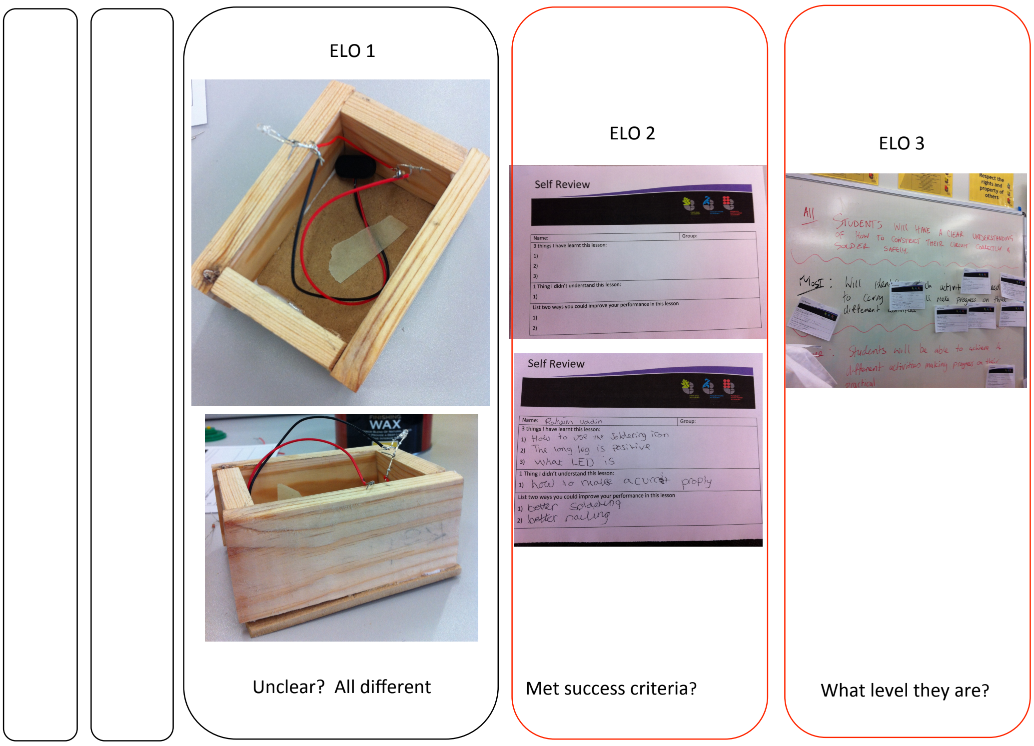
ILS:

To be able to select the correct drawing equipment and produce basic third angle orthographic drawing to a 3mm tolerance .... 'Clear'

Intended learning outcome: An orthographic drawing – drawn form

This was a difficult *ILS* involving three distinct learning foci: selecting the right equipment; producing an orthographic; and working to tolerance. The researcher did not consider the planned learning journey allowed this learning to take place and the lesson was unsatisfactory in achieving the *ILS*. The equipment was given to the students and tolerances were 'touched' upon by the teacher, but not in enough detail for the students to fully understand the concept. The students needed to be taught how to construct an orthographic drawing step-by-step in order to understand the conceptual and operational requirements of an orthographic drawing and this did not happen. Students learnt about constructing a 2D drawing in orthographic projection; however, the researcher did not see any evidence that the students learnt how to draw in orthographic projection or why they were being asked to do so. The *ELOs* did not show that the *intended* learning had taken place.

Figure 6.24 School C Post *LJCM*



ILS:

To have a clear understanding of how to construct the circuits .... 'Unclear'

To demonstrate good soldering (safely) .... 'Clear'

To identify which activities they will need to carry out to make progress................... 'Clear'

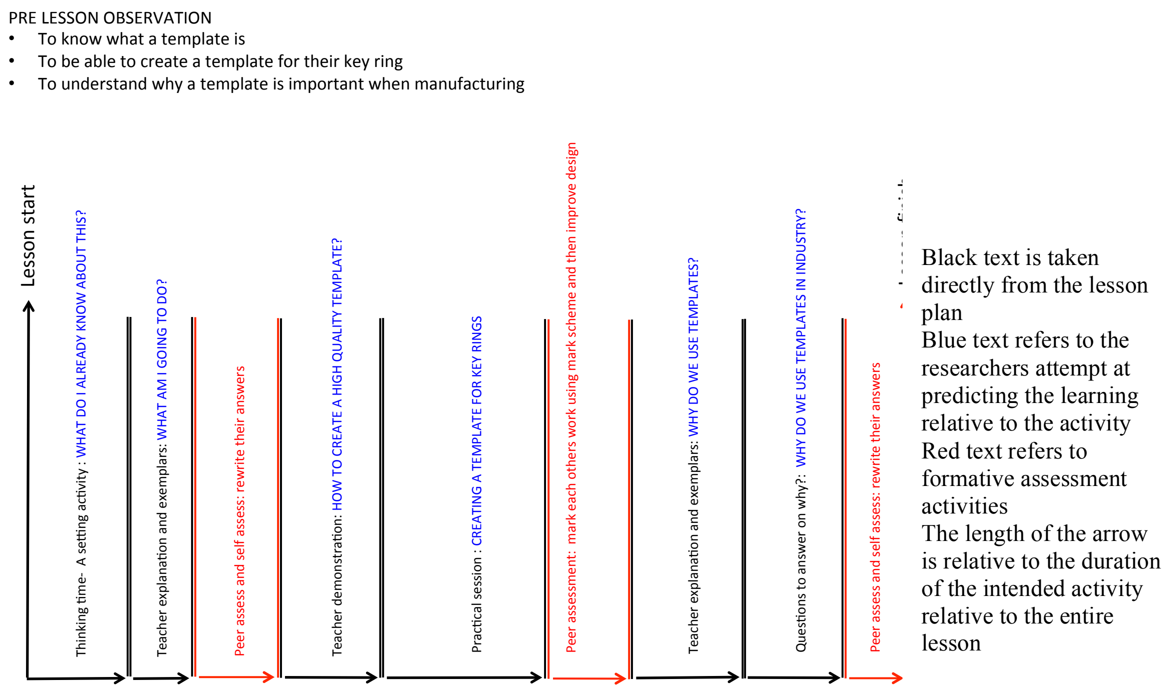
Intended learning outcome: a working circuit – practical form

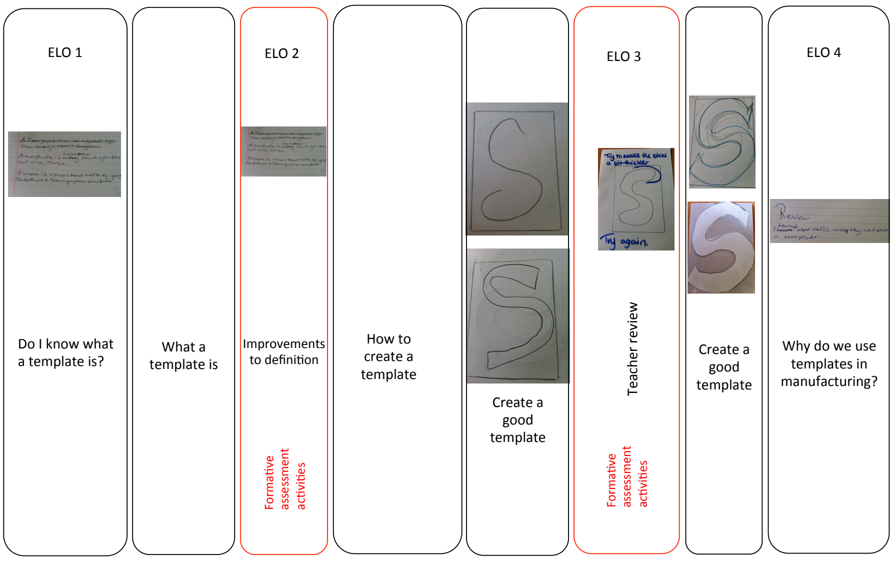
This was the last lesson of three Design and Technology lessons taught during one day. As a consequence, whilst the students were at different stages in their learning journey, they were all on task and clearly learning. All students soldered independently and all of their circuits worked. There was a sense of purpose and engagement in the lesson.

6.3.3 Comparison between pre and post *LJCM*

In order to assess the planning processes used by Design and Technology teachers, it is necessary to compare the *intended* learning journey with the actual learning journey. By classifying clarity in relation to the *ILS*, the relationship between 'unclear' or 'clear' *ILS*, the intended and actual learning journey, and the intended and actual learning outcomes can be investigated. The comparison should provide details on the effectiveness of the planning processes.

Figure 6.25 School F Lesson observation 1 Pre and Post *LJCM*

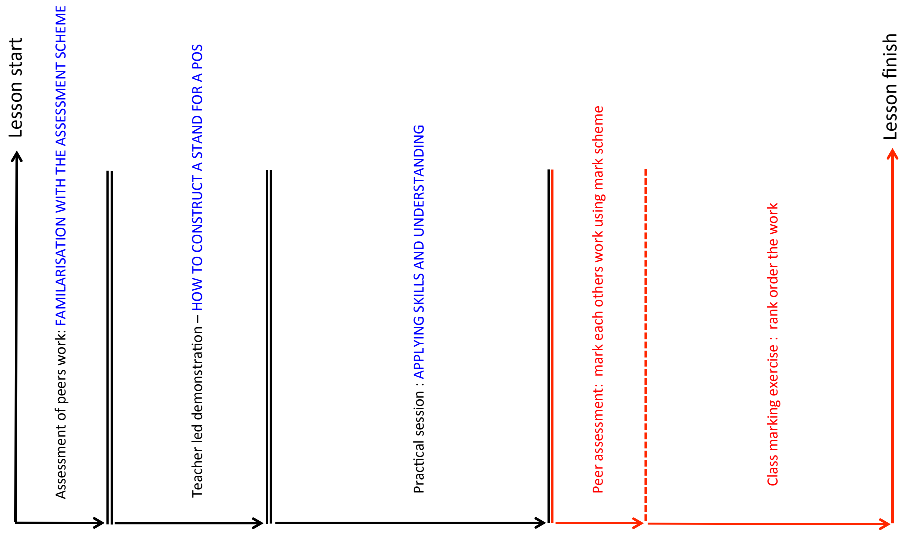




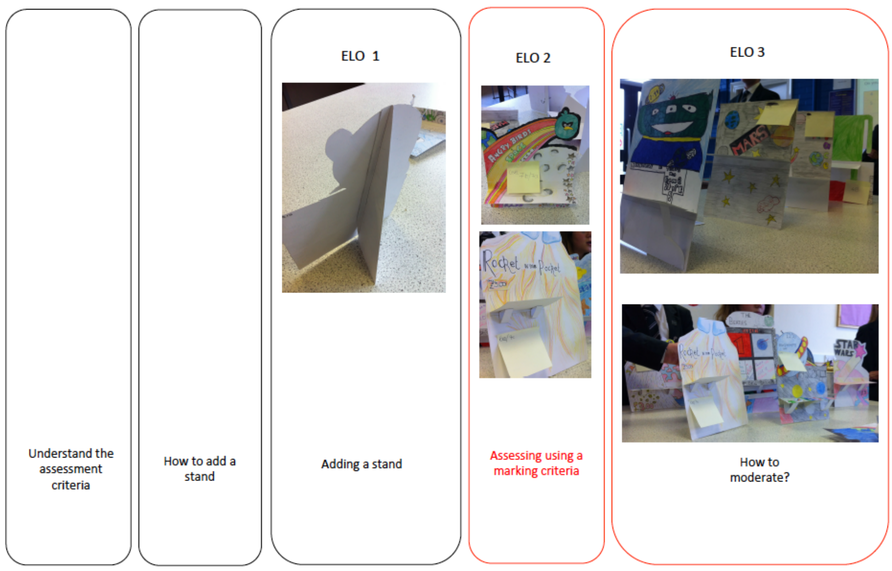
The *intended* learning journey and *actual* learning journey were similar, with the actual lesson only neglecting one formative assessment activity from the lesson plan, which involved the final review of the learning. What was noticeable was the pace of the lesson as a result of number of short episodes. Disappointingly, the teacher did not respond to the formative feedback and, therefore, the three *ILS* were not achieved. The *ELO* was also not achieved.

Figure 6.26 School A Lesson observation 2 Pre and Post *LJCM*

- To understand how to use the marking criteria to measure the success of the completed PoS

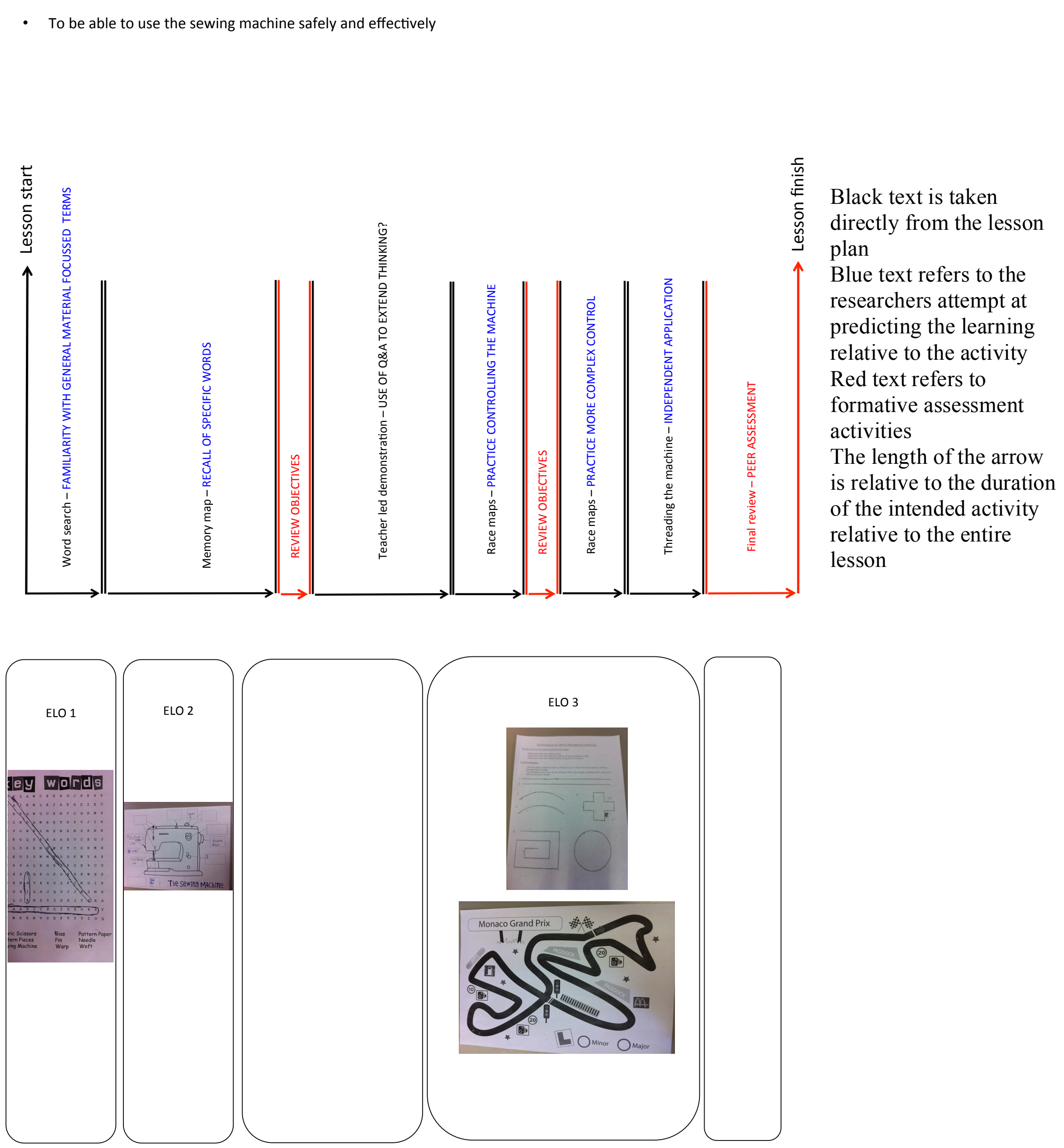


Black text is taken directly from the lesson plan
Blue text refers to the researchers attempt at predicting the learning relative to the activity
Red text refers to formative assessment activities
The length of the arrow is relative to the duration of the intended activity relative to the entire lesson



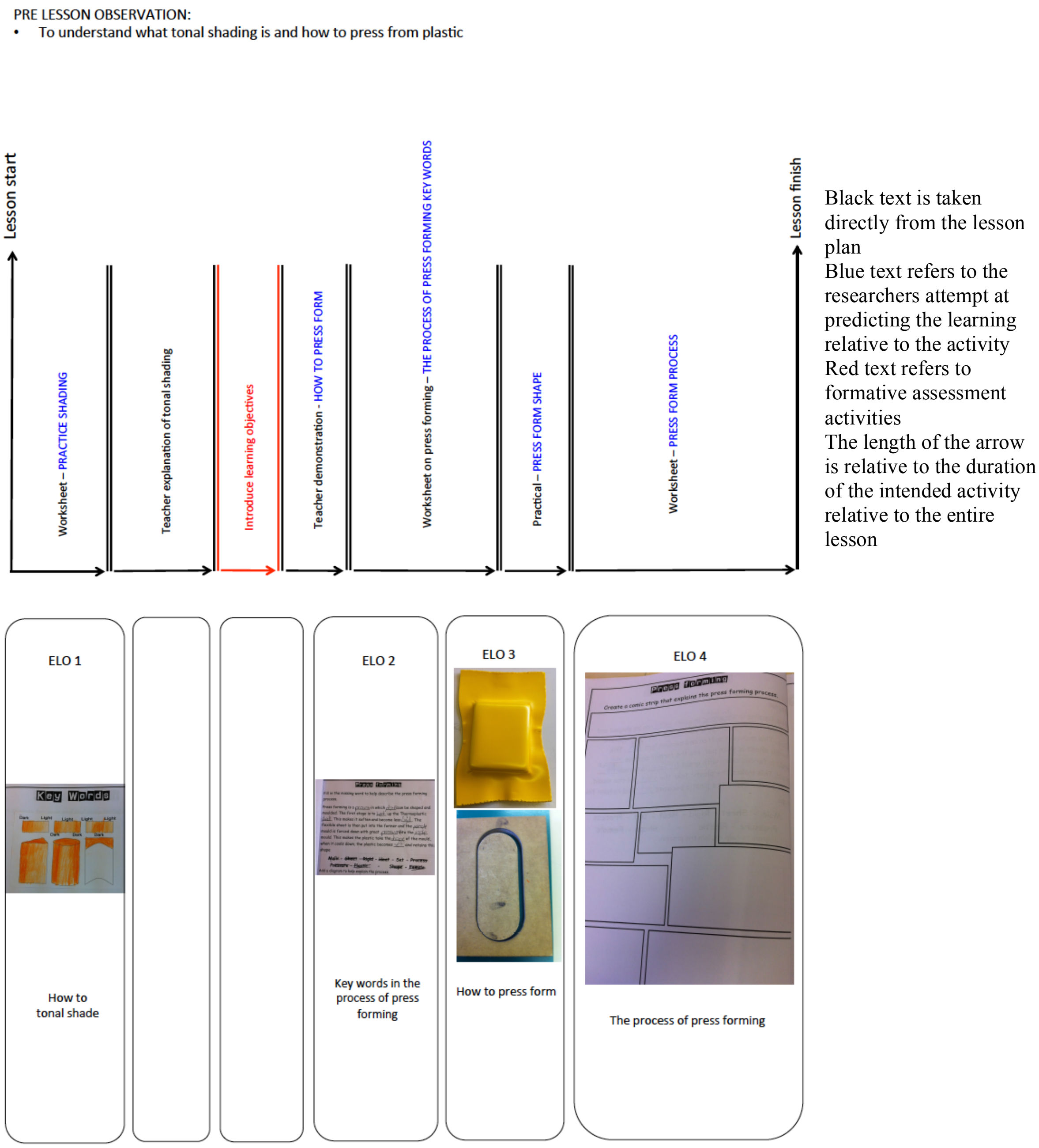
The lesson plan was adhered to. The practical activity took longer than originally planned and involved the least amount of learning as students were asked to ‘copy’ the teacher’s version of the stand. The formative assessment opportunities took a large portion of the lesson and did not allow the students to develop the knowledge relating to using the assessment criteria. Although the *ILS* was clear, the learning journey, even in plan format, did not allow the students the opportunity to develop the *intended* learning.

Figure 6.27 School G Lesson observation 3 Pre and Post *LJCM*



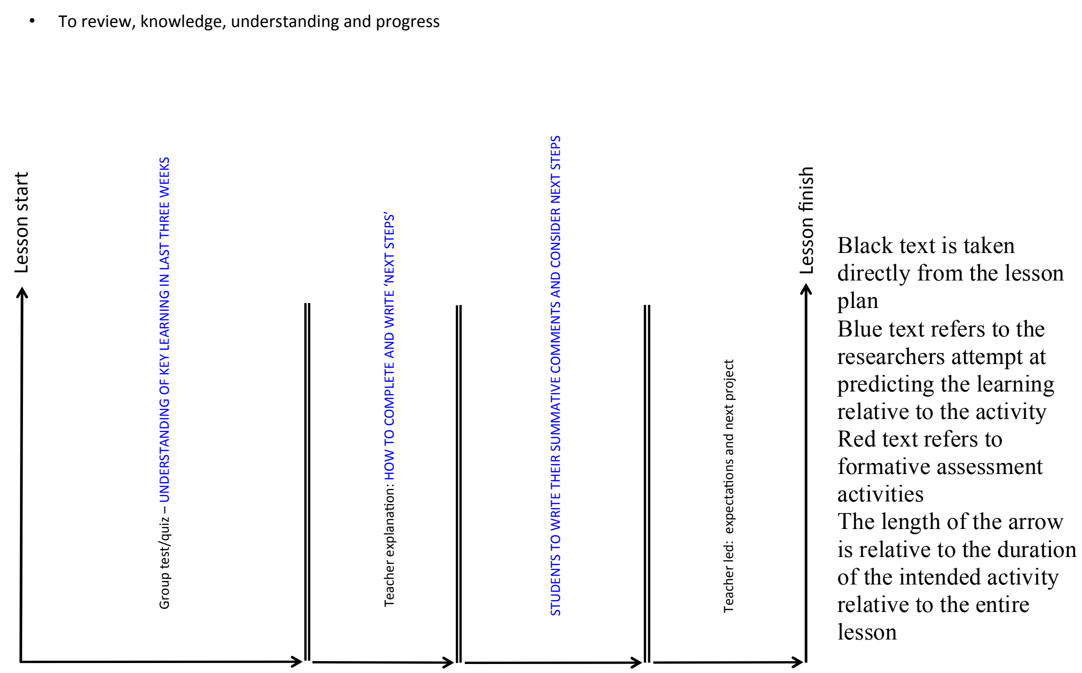
The *intended* journey involved nine episodes and the actual learning journey involved five learning activities. The three formative assessment opportunities were neglected. In plan, the lesson was pacey and several of the activities took longer than originally planned. The demonstration was clearly not planned, with questions tending to focus on 'what' or 'how'. For example, 'what do you think this is for?' or 'why do you think I need to do that?' There were issues with all the students being able to view the demonstration, with several students at the back not being able to see the pieces of the machine the teacher was focusing her questions on. As a consequence, the demonstration did not engage the whole class for the duration of the activity.

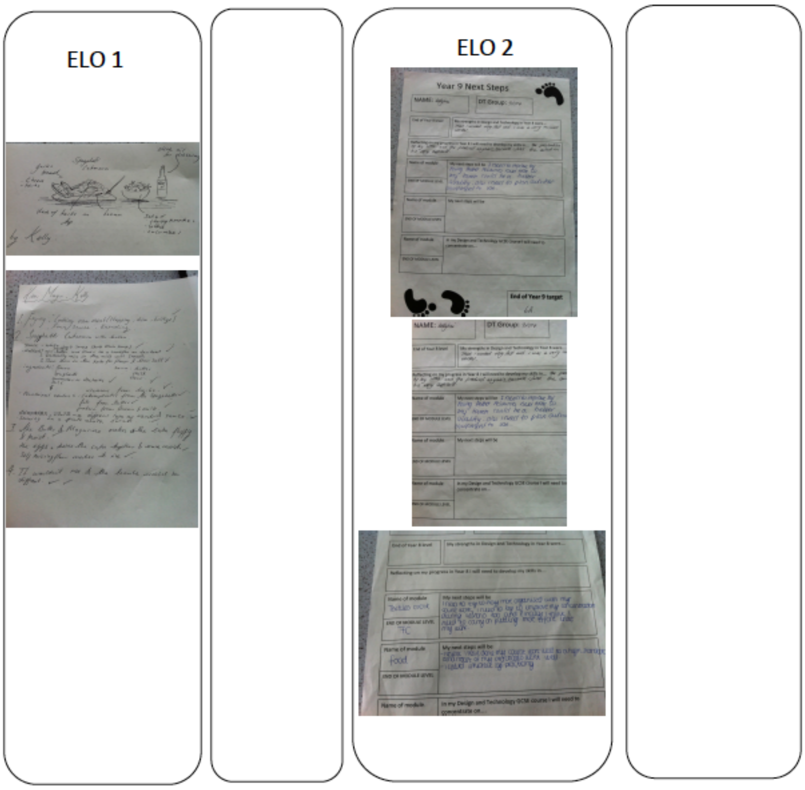
Figure 6.28 School G Lesson observation 4 Pre and Post *LJCM*



The actual lesson lost one episode – the formative assessment activity. This was a worksheet-based lesson, which involved some low-level learning activities. The *ELO* 1 was copied from an example off the board; *ELO* 2 was very simple, 'add the key words into the press forming process'; the teacher produced *ELO* 3 with the students watching. The final *ELO* required the students to explain the press forming process in another format, but was no completed. Consequently, the learning appeared to be minimal.

Figure 6.29 School A lesson observation 5 Pre and Post *LJCM*



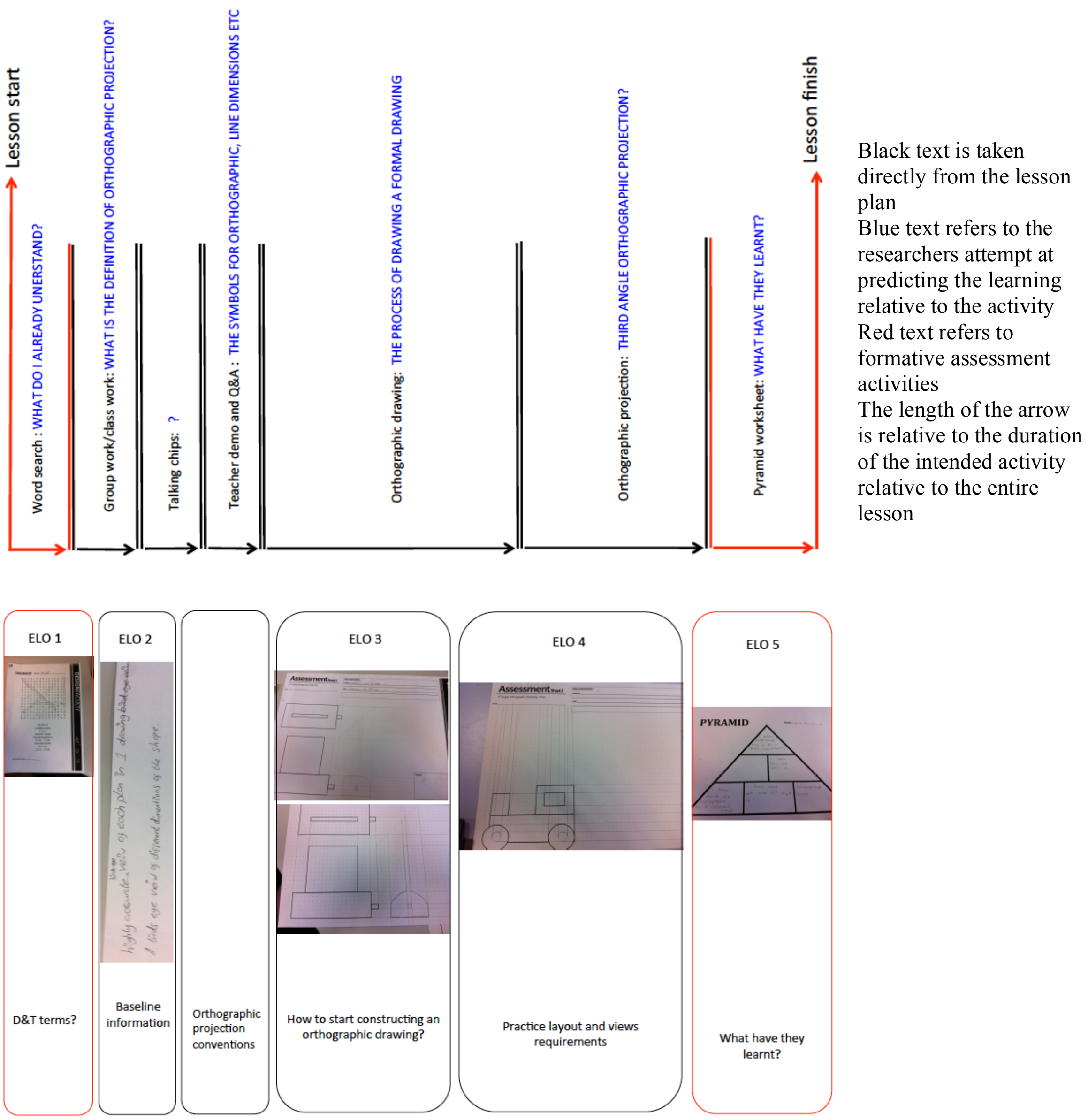


The teacher closely adhered to this simple lesson plan. However, the first *ELO* did not indicate the *ILS*, and the second, although given the longest timescale to complete, demonstrated s*urface* learning only. This highlights issues with the quality and quantity of learning.

Figure 6.30 School C Lesson observation 6 Pre and Post *LJCM*

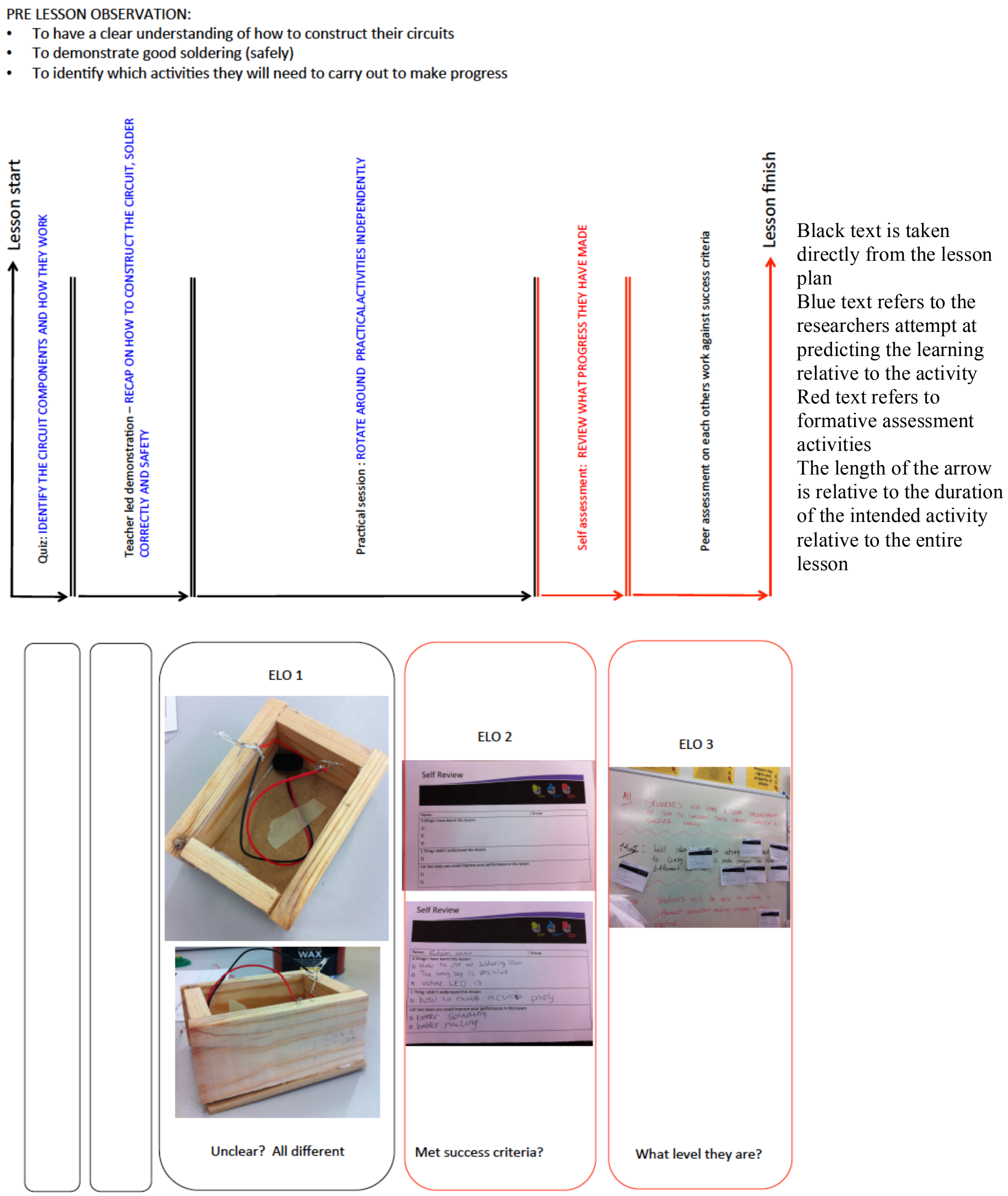
PRE LESSON OBSERVATION:

- To be able to select the correct drawing equipment and produce basic third angle orthographic drawing to a tolerance



The demonstration in episode 3 was reduced to less than five minutes, while the planning associated with the demonstration activity was minimal in terms of teaching and learning requirements. Students did not know what to do in episodes 3 and 4. Orthographic projection is a difficult concept in Design and Technology and requires careful planning and a 'step-by-step' approach to learning. The 'unclear' *ILS* and *intended* learning journey meant that the researcher could predict that the learning would be problematic. The *ELOs* did not evidence the *ILS*.

Figure 6.31 School C Lesson observation 7 Pre and Post *LJCM*



The *ELOs* do not demonstrate the entire learning that took place during this lesson. The students were asked to plan the activities and duration of the activities they had to achieve. This raises issues relating to the need to evidence all the learning and the production of unintentional learning outcomes, which will be discussed in Chapter Seven (pp. 222-261). The lesson involved students at different stages independently undertaking the task they had identified. The quality of the product, although unfinished, was good. The formative assessment activities reinforced the learning and, as the teacher said, provided ‘information for our next lesson’.

6.4 Summary of findings from Study 2

Study 2
To what extent do the *ILS* enable the *intended* learning to be achieved?
What methods are used to capture and gather learning?

- The *ILS* ‘guide’ the planning of the lesson
- Teachers plan activities not learning journeys
- The clarity of the *ILS* appears not to influence the planning procedures
- Changes to the plan are not prompted by formative assessment activities
- *ELOs* are by-products of learning- not operationalised through KS3 guidance
- Practical activities dominate Design & Technology lessons.

This section describes data collected from Study 3 which was analysed both quantitatively and qualitatively using QSR International’s NVivo 9 qualitative data analysis software. Study 3 involved two distinct parts: the results of the teachers’ focus group and the students’ focus group.

6.5 Part 3

6.5.1 Teachers' focus group

A total of 27 Design and Technology teachers were shown the seven sets of *ELOs* (see Appendix T). Small groups of teachers (between two and three teachers) were asked to consider and then predict the *ILS* related to the set of *ELOs*. The *ILS* were written down and collected by the researcher (see Appendices N and M).

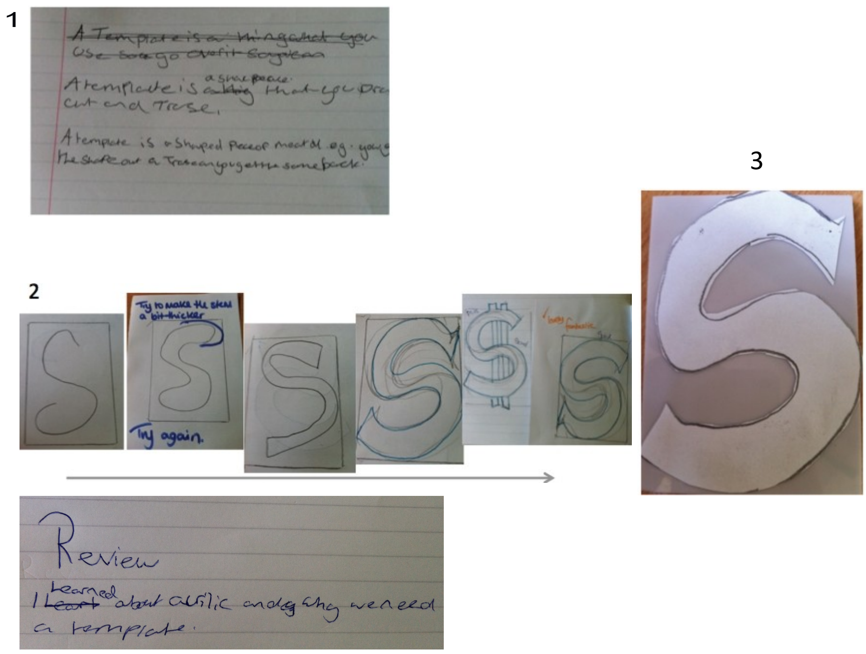
The responses from all the teacher groups, for each set of *ELOs*, were entered into QSR International NVivo 9 software in order to analyse the number and frequency of words used by the teachers in relation to the original *ILS*. The number of words used provided some indication of the ease of matching to the original *ILS*, while the frequency of words used provide evidence of the key words used by the teacher groups. The *ILS*, the *ELOs*, a brief analysis of the teachers' responses and a word frequency figure produced in QSR NVivo 9 will be presented for each lesson observation.

Figure 6.32 Teachers' prediction of *ILS* School F

D&T 1: Lesson observation 1

ILS for this lesson is:

To know what a template is
To be able to create a template for their key fob
To understand why a template is important when manufacturing.



Most teacher groups (11/12) identified the ‘use of templates’, with five groups mentioning batch production techniques or quality control in their predictions. Although the *ELOs* provided clear evidence of learning, there was no evidence relating to whether the student actually understood what a template was and how to design one. Two teachers mentioned ‘properties of acrylic’ taken directly from *ELO* 4.

QRS NVivo 9 word frequency results:

Number of words: 48 words were used to predict the *ILS.*

The teachers used 48 words to predict the *ILS* suggesting that the learning was not demonstrated clearly. 'To be able to use templates' or 'to understand templates' were the most frequently predicted statements, which are very close to the original *ILS*. The reference to acrylic was taken from the students' attempts at explaining their learning (*ELO* 4). The *ELOs* did not provide any evidence of manufacturing, production, or batch production. However, the use of templates is generally associated with this aspect of Design and Technology and, therefore, teachers made assumptions when predicting the learning.

Figure 6.33 Teachers' prediction of *ILS* School A

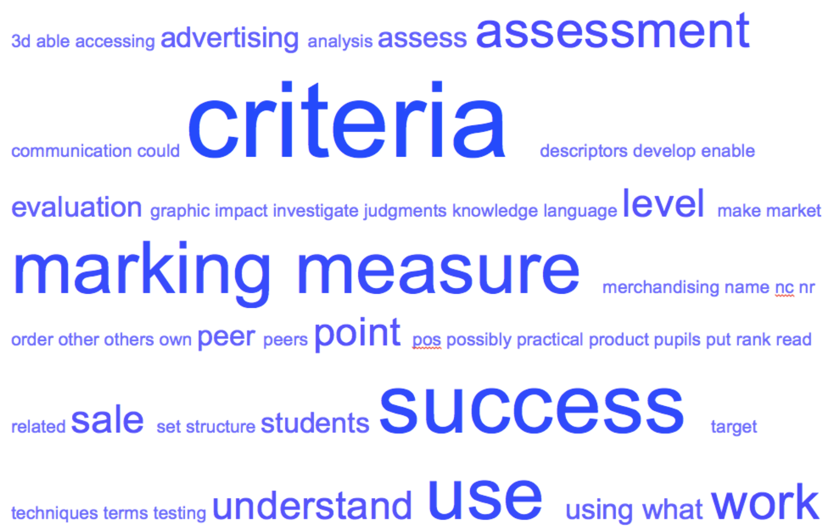
D&T 2: Lesson observation 2

The *ILS* for this lesson was:

To understand how to use the marking criteria to measure the success of the completed PoS (level 6)
To understand how to use the marking criteria to measure the success of the completed PoS and generate detailed suggestions for further improvement (level 7).

Most groups used 'post it' notes with levels on them to identify the learning. Eight of the twelve groups successfully recorded 'assessment criteria'. Several teachers looked at the product itself and presumed that the manufacture of the PoS display was the focus for the *intended* learning. The *ELOs* provide limited evidence of learning in relation to the *ILS.*

QRS NVivo 9 word frequency results:



Number of words used by the teachers: 59 proving the most difficult *ILS* to predict.

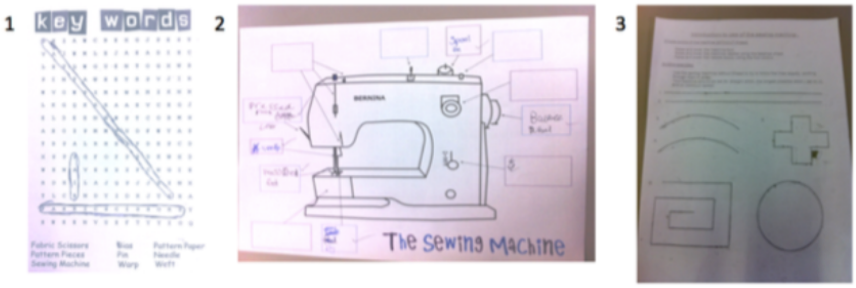
The most frequent word used by the teachers was 'criteria' with 'success' and 'marking/measure' ranking second. It is interesting that word 'use' was present as opposed to 'apply', as this was a word the researcher identified as potentially incongruous with the *intended* learning journey. Whilst 59 words were used to predict the learning, there was clearly an alignment between the learning demonstrated in the *ELOs* and the *ILS*.

Figure 6.34 Teachers' prediction of *ILS* School G

D&T 3: Lesson observation 3

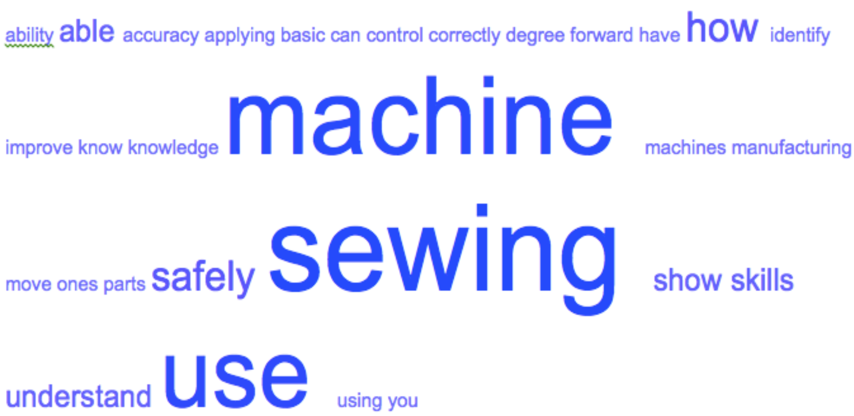
ILS for this lesson is:

To be able to use the sewing machine safely and accurately



Eleven of the twelve groups predicted this *ILS* correctly, with one exception that wrote down a general comment relating to applying manufacturing skills. This was considered by the researcher the most effective learning opportunity (both intentionally and actually) and produced clear *ELOs* that demonstrated the *intended* learning.

QRS NVivo 9 word frequency results:



Number of words: 30 indicating a low number of words to predict the *ILS*.

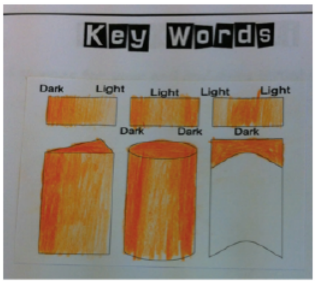
This is the least number of words used to predict the *ILS* by the teachers. This set of *ELOs* clearly demonstrated the *intended* learning. Although the word ‘accurately’ was not predominant, it did appear.

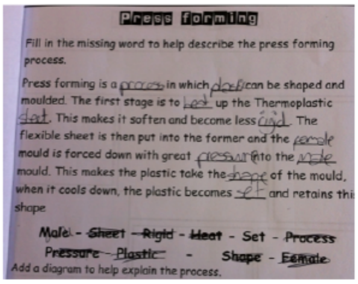
Figure 6.35 Teachers' prediction of *ILS* School G

D&T 4: Lesson observation 4

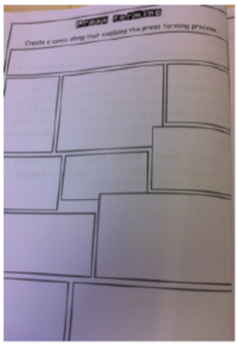
ILS for this lesson is:

To understand what tonal shading is
How to press from plastic (explain and safety precautions).

1


2


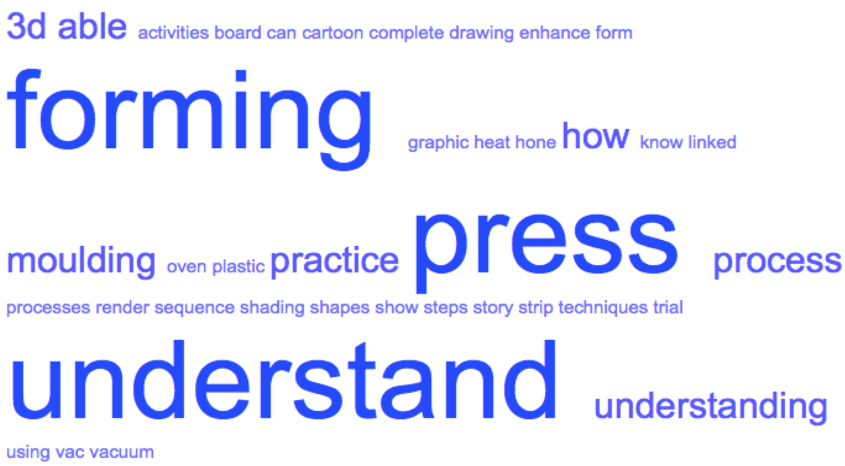

3



4

This was a confusing and badly planned lesson based upon an *ILS* that lacked clarity. However, due to the two distinct parts that involved two distinct activities, teachers generally predicted the *ILS* correctly. The *ELOs* were clear and showed exactly what had been learnt in relation to press forming.

QRS NVivo 9 word frequency results:



Number of words: 39 indicating an average number of words to predict the *ILS*

The majority of the *ELOs* focused upon learning press forming and, therefore, this was the dominant focus. 'Understanding press forming process' was clearly the most frequent *ILS* predicted by the teachers.

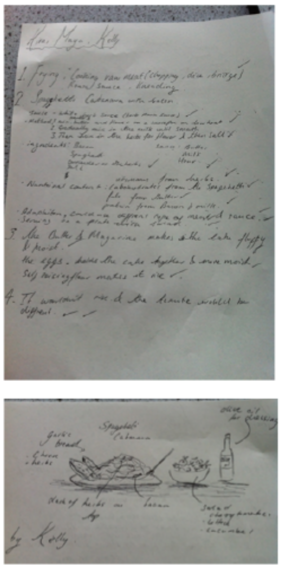
Figure 6.36 Teachers' prediction of *ILS* School A

D&T 5: Lesson observation 5

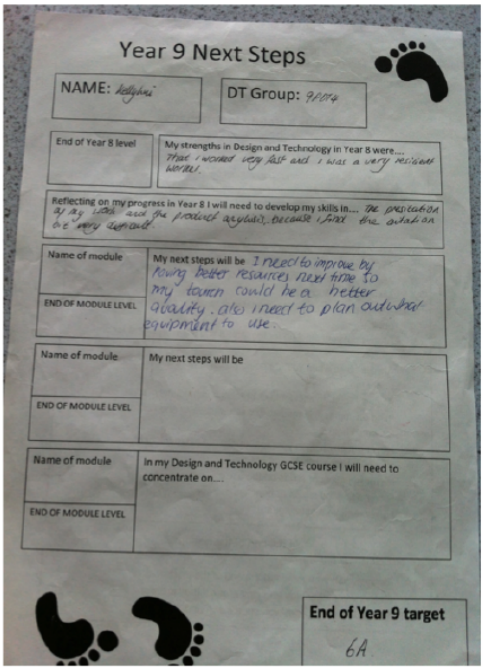
ILS for this lesson is:

To review knowledge, understanding and progress.

1



2



Year 9 Next Steps

NAME:	DT Group:
End of Year 8 level	My strengths in Design and Technology in Year 8 were....
Reflecting on my progress in Year 8 I will need to develop my skills in....	
Name of module	My next steps will be
END OF MODULE LEVEL	
Name of module	My next steps will be
END OF MODULE LEVEL	
Name of module	In my Design and Technology GCSE course I will need to concentrate on....
END OF MODULE LEVEL	

End of Year 9 target

6A

The *ILS* that related to the above *ELOs* were general and clues to the *intended* learning were obtained from the pro forma used by the teacher rather than the students' responses. The teachers' responses tended to be general, with 8 out of twelve groups suggesting the *ILS* focused upon 'target setting', with 'progression', 'improvement', 'strengths', 'targets' commonly used. Three groups (27%) did not respond to this set of *ELOs*.

QRS NVivo 9 word frequency results:

Number of words: 35 indicating an average number of words were used to predict the *ILS.*

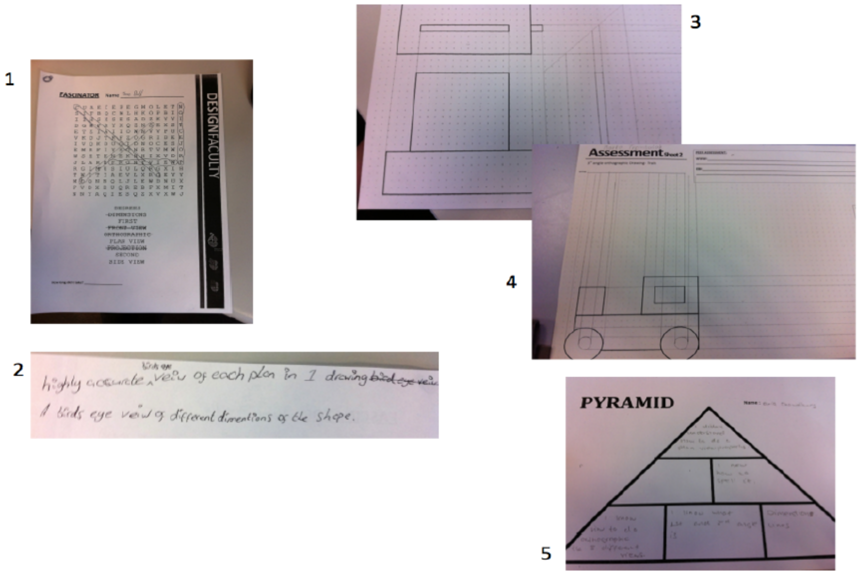
The four key words ‘review’, ‘knowledge’ ‘understanding’ and ‘progress’ were the most frequently used and matched exactly the *ILS*. However, the *ELOs* clearly do not show learning in relation to these aspects.

Figure 6.37 Teachers’ prediction of *ILS* School C

D&T 6: Lesson observation 6

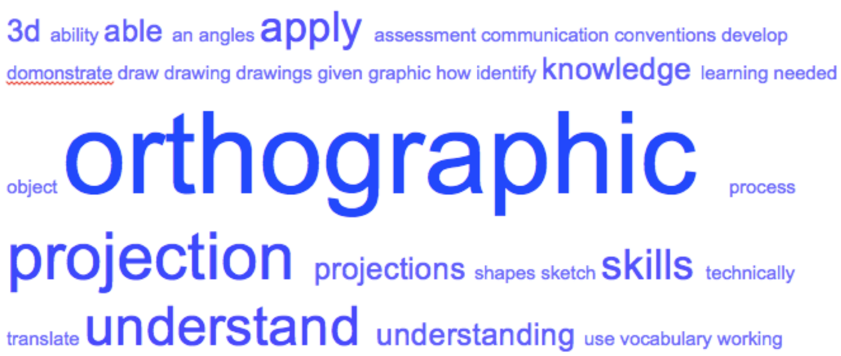
ILS for this lesson is:

To be able to select the correct drawing equipment
To produce basic 3rd angle orthographic drawings to a tolerance.



The two *ILS* for this lesson were classified as 'unclear' and specific in relation to the first *ILS* or very general in relation the second *ILS*. The suggestions from the teachers' focus groups tended to focus on the words 'orthographic projection'. The predicted *ILS* lacked specific details, for example 'to understand orthographic projection'. One group responded, 'to apply projections to a given shape and do a lovely workshop!', suggesting prehaps an emotional response to this particular set of *ELOs*. Two groups did not respond.

QRS NVivo 9 word frequency results:



Number of words: 36 indicating an average number of words to predict the *ILS.*

The key words from the word frequency analysis suggested an *ILS* of ‘to understand orthographic projections’, which is a very general statement and would be classified as ‘unclear’. Teachers appeared to make very general attempts at an *ILS* rather than ‘no response’. This could indicate a lack of understanding in relation to the requirements of an *ILS* although Study 1 findings do not show this.

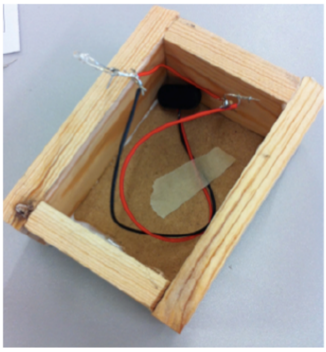
Figure 6.38 Teachers’ prediction of *ILS* School C

D&T 7: Lesson observation 7

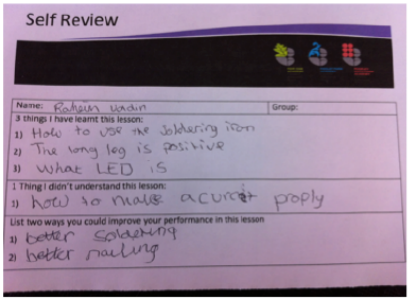
ILS for this lesson is:

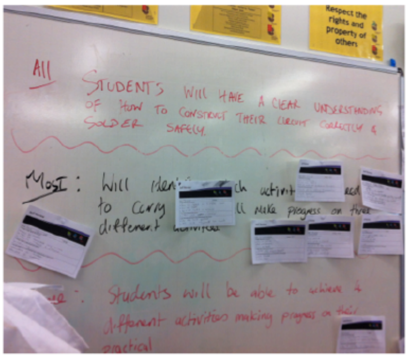
To have a clear understanding of how to construct their circuits
To demonstrate good soldering (safely)
Identify which activities they will need to carry out to make progress (3 or 4).

1



2

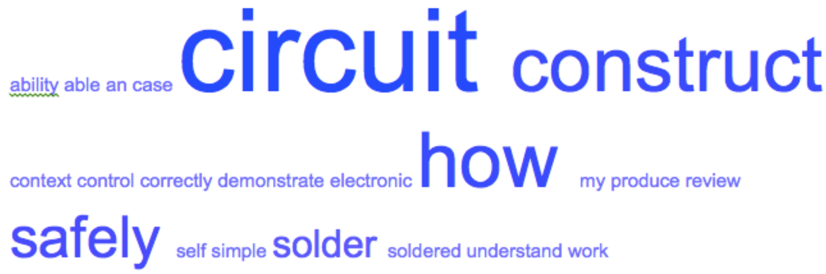




3

Half of the suggestions (50%) focused upon the production of a simple circuit and ignored the casing completely and the ‘post-it’ notes. This set of *ELOs* had the highest number of ‘no responses’ (33%). This might suggest that the teachers found it hard to identify the learning that was demonstrated. One group wrote down, ‘how to kill off electronics totally!’ again indicating some degree of emotional response to the *ELOs*. Discussions tended to presume the *ELO* 1 was the end product.

QRS NVivo 9 word frequency results:



Number of words: 22 the lowest number of words used to predict the *ILS*.

This is the lowest number of words suggested out of all seven sets of *ELOs*. The teachers' responses would suggest an *ILS* of 'how to construct a circuit safely', which is very close to *ILS* number 1.

Several of the *ELOs* collected by the researcher during this lesson observation demonstrated learning, but not the learning identified and described in the *ILS*. *ELO* 1 demonstrated a clear understanding of how to construct a circuit and could demonstrate good soldering. However, with reference to the 'safely' aspect of this *ILS*, could 'safely' be demonstrated through the production of an *ELO*? Or does the teacher infer that, because the activity was achieved successfully, the 'safety' aspect is integral in the learning? QCDA (2010) guidance suggests that learning outcomes can include notes by the teacher and it may be that the teacher recorded this 'safety' aspect of the *ILS* for each student in note form, which provided a learning outcome unknown to the researcher. *ELO* 1 could also demonstrate learning in relation to construction or use of tools and equipment. There was no evidence of learning in relation to the third *ILS*, given that students were all busy on different tasks and at different stages in the manufacturing process. *ELOs* 2 and 3 were formative assessment activities, but only provided formative feedback for the subsequent lesson. The teacher in this case made direct reference to these learning outcomes being used to inform the next lesson.

6.5.2 Students' focus group

The participation of students in Study 3 was carefully considered. The decontextualisation of the *ELOs* and the unfamiliar context for the participating students could affect their responses. However, it was originally considered Key Stage 3 students would be able to identify some aspects of the learning demonstrated in the images of *ELOs*, although the researcher was unsure to what degree or extent the students would be able to do this. The results highlight the importance of context when identifying possible learning from *ELOs.* Consequently, the results from the students' focus group are presented in Appendix O and relatively brief findings are presented below.

Four year 9 students, one male and three female students, were asked to look at each of the lesson observation *ELO*s, discuss the possible learning and then predict the *ILS* (see Appendix O for the raw data). The findings are presented below with accompanying field notes taken whilst the students discussed possible *ILS*.

A very general discussion took place concerning possible learning, although there was no clear identification of the learning demonstrated in the *ELOs*. The focus was on the language suitable for the 'all, most and some' approach with students identifying possible differentiated tasks. Differentiation between 'All', 'Most' and 'Some' can be referenced to Bloom's (1956) taxonomy of learning objectives and the cognitive domain, which includes the following knowledge structures: knowledge; comprehension; application; analysis; synthesis; and evaluation. The students that participated in Study 3 were clearly familiar with this learning framework and employed it consistently to the given task.

The *ELOs* referred to the sequence they were produced during the lesson, although the students presumed that the images related to differentiated activities.

6.6 Summary of findings from Study 3

Study 3

Does the evidence of learning produced in Design & Technology lessons demonstrate the *intended* learning?

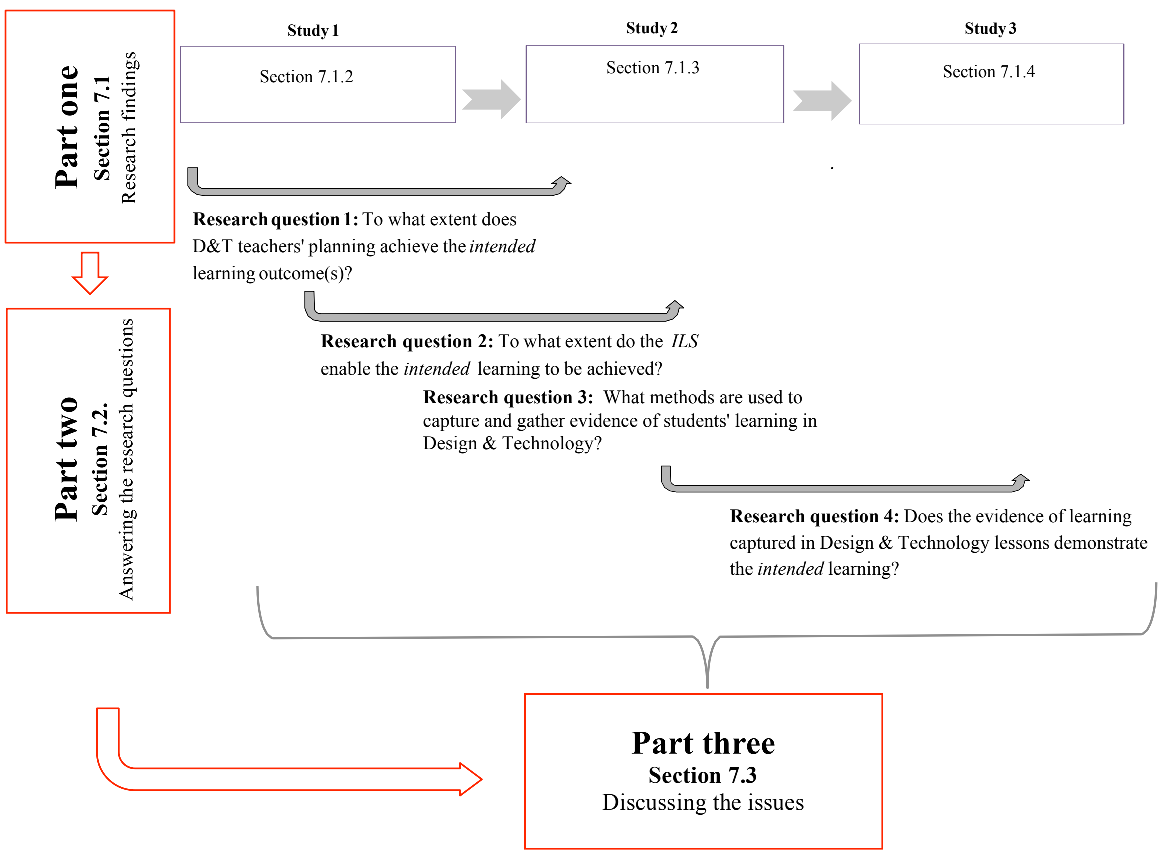
- *ELOs* demonstrate general learning
- Simple *ILS* were the most successful to predict
- Teachers assumptions influence predicting learning
- Design & Technology teachers focus on *made* products
- The predominant focus of the *ELO*s tended to dominate the predicted learning
- Teachers tended to identify ‘clues’ which provide the focus for predicting the learning
- Students found it difficult to discuss and identify learning demonstrated in the *ELOs*.

Chapter Seven will provide a brief summary of the results and then address the four sub-research questions in detail. A thorough discussion of the themes that have emerged throughout this research study will also be presented, providing a ‘holistic’ approach to analysing the key findings and focus upon the inter-relationships between the three studies.

Chapter Seven: Summary of the Research Findings and Discussion

This chapter is divided into three parts, as shown in Figure 7.1 below. Part one presents a summary of the key findings from this research study, presented in relation to Studies 1, 2 and 3. Part two applies these key findings to the teaching-learning process, providing answers to the four sub-research questions. Finally, Part three explores the implications of the key findings on *classroom-based learning* and the contributions these key findings make to planning and identifying learning progress in Design and Technology education within current policy and practice.

Figure 7.1 The format of Chapter Seven



The findings from this research study have significant implications for Design and Technology teachers in relation to the learning associated with the subject and how it can be planned to ensure effective teaching, planning for learning, planning for learning opportunities and planning learning outcomes. As a consequence this work, in my view, has the potential to make a meaningful impact on the assessment of learning in Design and Technology.

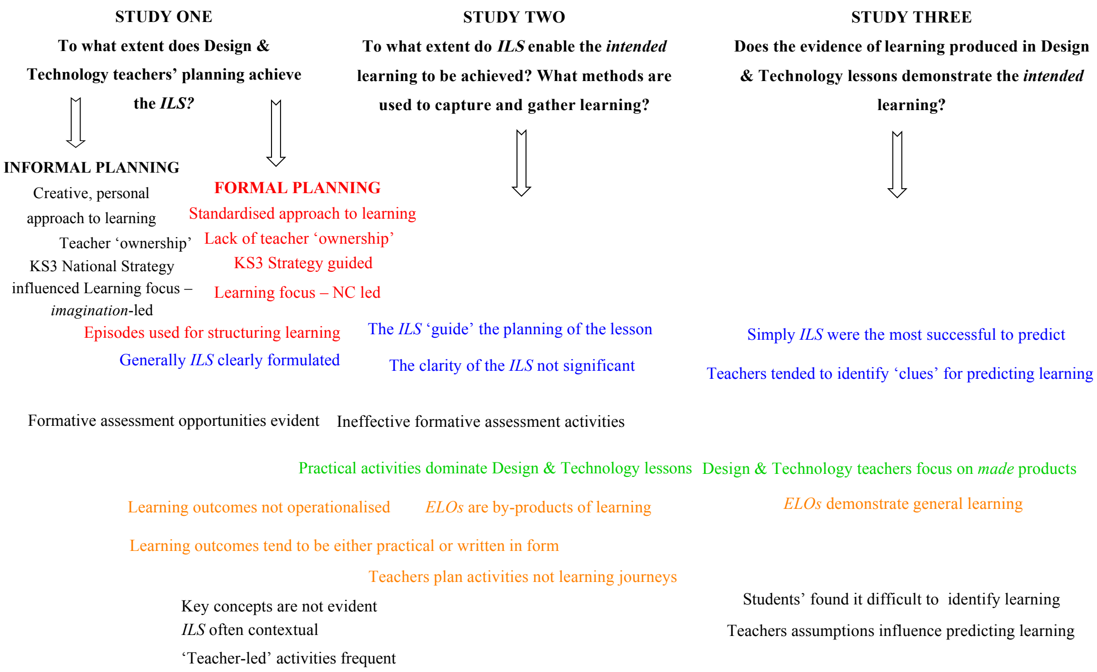
Currently, the perceived value of Design and Technology as part of the National Curriculum is suffering from a lack of clarity (Wakefield, 2013). This research study suggests possible reasons and provides practical *classroom-based* solutions.

7.1 Part one

7.1.1 Summary of Studies 1, 2 and 3 research findings

The intention of this research study was to provide insights into the teaching-learning process. Figure 7.2 presents an overview of each summary of findings and highlights, using colour, the themes that have emerged across the three studies.

Figure 7.2 Overview of key themes to emerge from research findings



(A larger version of Figure 7.2 can be found in Appendix Z).

7.1.2 Study 1

Study 1 focused upon the ‘pre active’ phase of the teaching-learning process and the processes and procedures used by Design and Technology teachers to plan for learning. The key themes that emerged from Study 1 will be discussed below.

Theme 1: Formal planning procedures

This research study found the use of whole school lesson planning pro formas to be standardised in secondary schools in England. Study 1, part 2, revealed that such lesson planning pro formas were generally designed by senior teachers/managers and tend to be based upon a particular view of learning, or a particular learning theory. By prescribing the approach to planning through the design of the planning pro forma, teachers were removed from the planning process, which became a simple procedural task (Milkova, 2014). The findings from Study 1, part 2 support this view, with teacher comments including, ‘There is no ownership of the planning’ (Teacher A, 2012) (see Appendix P for teacher responses to Study 1, part 2).

The whole school planning pro forma generally followed a ‘dominant’ approach to planning for learning (Tyler, 1949) in terms of overall design and structural layout. The ‘dominant’ approach is based upon the formulation of *ILS* and a clear notion of the required learning outcome(s). Whilst the planning process, in regard to the learning journey, is governed by the specified learning, it is also dominated by the production of learning outcomes (Hewitt, 2013). As discussed in Chapter Two (pp.8-42) the focus for the planning process is not on the process of learning, but rather on the production of, or assessment methods associated with, learning outcomes. Furthermore, by removing teachers’ attention from the learning process, the details of that process, interaction between the different aspects, and understanding of the process is negated; in fact, the purpose of the learning process becomes distorted (Hussey and Smith, 2008).

Current literature on planning processes deems the ‘dominant approach’ or ‘objectives model’ (Elliott, 2001) to planning as primarily managerial in intention, satisfying administration requirements. The ‘dominant’ planning process can be considered a formal planning procedure, as it requires the teachers to follow an externally prescribed process. The use of lesson planning pro formas tends to be limited to formal observations; therefore, it can be assumed the planning pro forma does not entirely support methods for planning day-to-day lessons. However, there were suggestions (see Study 1, part 2, p. 176) that the planning pro forma was useful when considered as a ‘quality assurance’ tool, with comments such as ‘It does not help me plan as such, but does help as it ensures everything is ok with the lesson’ (Teacher C, 2012). Such reassurance gained by filling in the whole school pro formas appeared to be consistent, irrespective of the teachers’ teaching experience, and is considered beneficial by both the DCSF/QCA (2007) and Ofsted (2008; 2011).

Several teachers discussed the benefits of using the standardised pro formas. Comments such as helping to ‘order my thoughts, or changing the sequence’ were common, with one teacher explaining that the pro forma helped her ‘craft the lesson’ (Teacher F, 2012) in much the same way as using PowerPoint slides appeared to. In practice, the teachers seemed to use the pro forma to ‘finalise’ their thinking about the lesson, regarding it as the concluding stage in the planning process, the cognitive phase having come prior to this point. In fact, Study 1 found no evidence that the documents were being used as ‘working documents’; notes or amendment were not evident on the documents themselves.

Planning pro formas provide the teacher with the opportunity to formulate and clarify their thoughts, albeit within a specified framework, and ensure the teacher considers information relevant to the teaching-learning process; in particular, information relevant to the school context, including differentiation, resources, literacy and numeracy, homework and health and safety issues (see Appendix E for examples of planning pro formas). ‘Planning is a powerful tool for helping teachers clarify the *intended* learning, deepen and extend their PCK, design learning activities and anticipate AfL interactions’ (Moreland, 2008: 46). Whilst PCK is developed through a teacher’s planning, preparation and teaching (Shulman, 1987), it will clearly be affected by the use of standardised whole school pro formas, the ‘dominant’ approach to planning and prescribed views on learning or learning theories specified by individual schools.

The level of detail required from the lesson planning pro formas varied significantly between schools. Lesson plans from schools A and C required the most information from the teacher. The lesson plans from these two schools were particularly problematic to translate into pre *LJCM*, as the specific learning was often difficult to isolate or confusing when attempting to identify.

The lack of ownership of the formal planning process and a requisition to follow a ‘dominant’ approach to planning has clearly affected Design and Technology teachers’ planning approaches and, consequently, the teaching-learning process. Whilst the planning process required teachers to translate syllabus guidelines and institutional expectations, teachers also incorporated their own beliefs and ideologies of education and the subject specialism into plans for teaching lessons. It was evident throughout the research study that teachers’ own beliefs about Design and Technology teaching and learning were combined with their professional knowledge when planning learning activities (Shavelson and Stern, 1981; Calderhead, 1984), albeit within a prescriptive framework.

Theme 2: Informal planning processes

Findings from Study 1, part 2, revealed that, in practice, teachers use a variety of different *informal* approaches to planning, supporting the current research on teacher planning presented in Chapter Four (pp. 82-110). Teachers tended to plan at various times of the day by mentally focusing on issues that need their attention (see Hagger and McIntyre, 2006). This research study’s findings support this claim, with a myriad of *informal* approaches being highlighted by the Design and Technology teachers, including: group discussions; talking to wife/technician/colleague; scribbling notes; mind mapping; thinking in the car. Such *informal* planning approaches appear to be very personal, with several teachers having devised methods that suit them and their particular circumstances; however, teachers found it difficult to articulate their planning process in terms of the mechanisms or detailed processes involved.

Planning tended to be stimulated by a 'thought' often triggered by an inspiration, for example a product or television programme, which was then translated into a learning activity or learning journey. The need for a creative aspect in the planning process was a recurring theme in teacher responses (see Calderhead, 1996), and will be discussed in relation to creativity associated with Design and Technology education in Part three.

The use of PowerPoint presentation slides to formulate the learning journey was a common method of *informal* planning, often justified by the degree of flexibility and creativity PowerPoint slides provided. The software allowed teachers to develop and clarify their thinking about the learning journey, translating vague ideas into an effective learning journey. Ideas are formed and after elaboration, develop into mental plans or images and act as classroom scripts or guides (Morine-Dershimer, 1979). Several teachers used the common analogy of 'a journey' (Peters, 1965) when discussing their planning processes. For example, one teacher stated, 'I start with the aim of the lesson and what I need them to have learnt by the end and then think about how I can get there' (Teacher D, 2012). PowerPoint slides provided the teachers with a clear 'image' of the learning journey, slide by slide, and a mechanism for teachers to visualise the *intended* lesson and learning journey. In this regard, PowerPoint slides also allowed the teacher to rearrange the learning journey episodes in order to ensure a logical, progressive learning journey. The concept of 'reworking a film strip' in relation to visualising a learning journey clearly relates to this aspect of teacher planning (see Morine-Dershimer, 1979).

The use of PowerPoint slides when planning for learning exemplifies some of the current research on planning relating to ‘planning and images’ borne out in the literature review (Clandinin, 1985; 1986). Such an approach seems to be characterised as a *mental rehearsal* of ideas and knowledge about students, the school and the curriculum. Without the notion of planning in the form of visualisation, it is difficult to anticipate the ways in which what has been planned may unfold in the classroom. More experienced teachers approached planning as the anticipation of what might happen rather than their determination of what would happen: that is, planning as visualisation, rather than planning as a template (Mutton, Hagger and Burn, 2011). ‘Novice planning processes’ identify this ‘image making’ as a significant feature and a sign of growing confidence and belief in teaching and planning structures (John, 2006).

Theme 3: The ‘learning focus’

The majority of teachers in Study 1 discussed ways of deciding upon a ‘learning focus’ at the start of the *informal* planning process. This is despite the fact that ‘learning’ was not the key stimulus or motivation for the planning process, and certainly was not the first response to the survey question ‘how do you plan for learning?’ Teachers specified minimal details in regard to processes for formulating learning, offering far more information on planning for the resources to support the learning intention. As suggested by Tsui (2002), teachers consider materials and resources, students’ interests and abilities as the first aspects in the planning process.

The majority of the teachers could identify and formulate learning into succinct sentences in line with the recommendations set out in the Design and Technology Framework and training materials (DfES, 2004b). However, several examples of *ILS* identified learning that was general and unfocused (Bain, 2012). The use of two verbs within the same *ILS*, for example, ‘to understand how to demonstrate…’ or ‘to be able to design…’ was problematic, as it tended to confuse the learning focus and made identifying the precise learning difficult. When teaching students 'to understand how to demonstrate', is the emphasis on their understanding of 'how', or on the students being able to 'demonstrate'? It is a subtle difference, but one that would require the teacher to plan a different teaching strategy and a different learning outcome to demonstrate the *intended* learning.

Theme 4: The learning journey

Through the planning process, the *ILS* are transformed into teaching and learning activities, and require the teacher to structure a planned learning journey, which involve a variety of episodes (DfES, 2004b). The *formal* planning process and standardised whole school planning pro forma provide a pre-specified structure, involving distinct episodes of teaching and learning for each lesson and every subject irrespective of the lesson content or learning focus.

Study 1, part 1 revealed a lack of detail in relation to the teaching, learning and assessment activities evident in the planned episodes. Such an approach to planning encourages discreet activities that can be isolated in terms of learning. Teaching strategies were either not specified or were vague in their description, and learning was often defined through what the students were going to do during the lesson. Details on the formative assessment activities were minimal, often stating 'peer assessment' or 'mini white boards', suggesting that the teachers had specific experience in these activities. Although in relation to the planned question and answer sessions, there was no information on what questions were to be asked; therefore, it could be argued that teachers 'improvised' to address the perceived needs of the class (McAlpine, Weston, Beauchamp, Wiseman and Beauchamp, 1999). It can be presumed, therefore, that the lesson planning pro forma acts primarily as a prompt during the 'inter active' phase (Leinhardt, 1988; Clark and Yinger, 1987).

Whilst it is clearly difficult to determine the required level of detail needed to provide an effective learning experience, or if indeed the teachers were planning in ‘note form’, this was further investigated in Study 2, when the learning journey was observed and could be compared directly to the lesson plan (see Study 2, p. 142). This provided the opportunity to compare the level of detail in the lesson plan with the degree of learning progress and will be discussed in more detail in Part three (p. 246).

Through the use of whole school lesson pro formas, formative assessment activities were integrated into the learning journey; as a result, there was clear evidence that teachers were planning formative assessment activities alongside the teaching and learning activities and not as a ‘bolt on’ at the end of the plan (Sondergeld, 2010: 77). This is a benefit of whole school planning pro formas. Surprisingly, the survey results in relation to the *informal* planning processes revealed in Study 1, part 2, provided no evidence of formative assessment being included or incorporated into *informal* planning; there was also no mention of the need to review the learning, or ascertain the level of learning.

‘Teacher talk’ was the dominant form of teaching strategy, with two thirds of these activities being described as ‘teacher explanation’ or ‘teacher discussion’. Just under half the lesson plans involved either group discussion, group work or paired learning, involving students talking to, or with, other students. Relevantly, Watkins’ (2003) third approach to learning is located within a socially constructed paradigm, where learners build knowledge as part of doing things with others and construct meaning together in social settings. The importance of the learner interacting in social settings has been discussed at length (Trebell, 2007; Hanks, 1991; Eraut, 2000) (Chapter Two, p. 8). Here, it appeared to be an important aspect of Design and Technology lessons and has implications when considering how learning might be demonstrated, captured or gathered when working in ‘social’ groups.

Lesson episodes tended to be 'teacher-led' rather than 'student-led' (Eraut, 2000); that is, activities were 'managed' or 'controlled' by the teacher, suggesting a traditional approach to teaching and learning, with characteristics of a behaviourist paradigm. The teacher dictates what knowledge the learners will learn, in what order they will learn it, and how it is to be learnt and, indeed, how it will be demonstrated. When learning outcomes become predictable and measurable (Kennedy, 2007) and indeed, managed by the teacher, the role of the student in the process of demonstrating their learning is questionable and will be discussed further in Part three below. Of the five classifications of learning (DfE, 2004c), 'acquiring and applying knowledge' was the most frequent approach to learning, supporting the literature review findings presented in Chapter Two (pp. 8-42) (see Huit and Hummel, 2006; Eraut, 2000; James, 2002) and aligning to aspects of a behaviourist approach.

Demonstrations were a common activity used by Design and Technology teachers and tended to take up a large proportion of the lesson duration. Developing skilled knowledge can often rely on demonstrations, a teaching strategy embedded in constructivist learning. In plan form, the teachers provided no evidence of the knowledge, skills and understanding relating to the particular demonstration; for example, teachers would simply state 'demonstrate drilling'. The demonstrations observed in Study 2 tended to be one-dimensional in relation to learning, in as much as they focused on the procedural knowledge involved in the activity. Whilst this was important, teachers tended to omit any reference to other forms of learning, such as conceptual or technical knowledge. Thus, demonstrations did not provide the full potential of learning opportunities. Petrina (2007) contends that demonstrations must involve more than how to perform the task, with the teacher modelling what they know and the level of skills and safe practice attained. The learning outcomes associated with demonstrations involved step-by-step instructions on how to achieve the task (for example, Figure 6.21, p. 192).

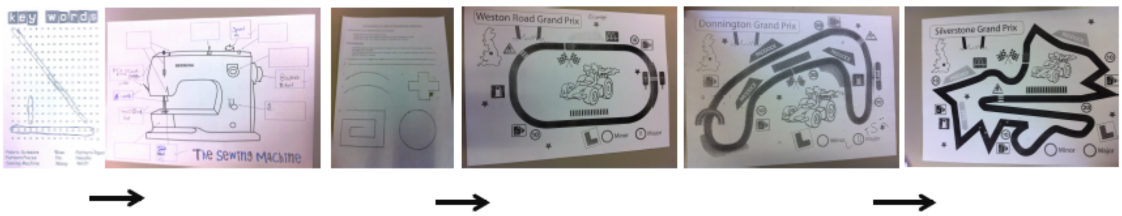
Theme 5: The role of learning outcomes

Identifying possible learning outcomes was not a common or standardised activity in the 'pre active' phase. *ILS* that included an indication of learning outcomes or *ELOs* were often confused and inconsistent, both between teachers and across the departments. The concept of an *ELO,* as a learning outcome identified and produced during every episode, was not evident in any of the plans. Design and Technology teachers often identified a single learning outcome per lesson, generally relating to the final outcome of the lesson or series of lessons, presumably demonstrating a culmination of learning progress.

The largest numbers of learning outcomes were classified as 'attainment' (Brown and James, 2005) supporting the current research presented in Chapter Three (pp. 45–80), and Chapter Four (pp. 82-110). Attainment often refers to knowledge associated with the subject domain or subject construct and is described by the TLRP (2009: 2) as 'school curriculum based or measures of basic competence in the workplace, frequently open to straightforward traditional means of assessment'. Indeed, the prevalence of 'attainment' based learning outcomes suggests that teachers are using learning outcomes in a manner that complements OBE. The current focus on outcomes as 'attainment' based learning outcome supports this approach. It could be argued that for teachers to have taken 'ownership' of the notion of a learning outcome, there would be greater evidence of a wider range of learning outcomes through teachers modifying and adapting the use of learning outcomes. As Wiliam (2006) contends, 'top down' initiatives may have an effect on pedagogy, but changing what and how teachers do what they do in the classroom needs to come from teachers themselves.

Findings revealed that Design and Technology teachers could predict the learning demonstrated in the sets of *ELOs*, albeit within the framework for *classroom-based learning*. Predicated *ILS* were often general statements that focused on a specific aspect of the Design and Technology Programmes of Study. However, the teachers did not interpret the *ELO*s sequentially, but rather as ‘standards files’, a term introduced by QCA (2008a) relating to a file or folder of a student’s work that provides evidence of a particular standard or representing a specific attainment level. The images of learning outcomes were comprehended as a ‘group of student’s work’ and not as a learning journey or progression evident in the sequence of *ELOs*. Figure 7.3 below shows the *ELOs* produced by School G, Lesson observation 3, in the order they were produced by the students and gathered and captured by the researcher. Presenting the *ELOs* in such a way provides the opportunity to see the students’ learning progress in relation to the *intended* learning. In this format, the *ELOs* provide clear evidence of learning.

Figure 7.3 *ELOs* representing learning progression



It can be assumed, therefore, that the participating teachers were not approaching lesson planning in terms of developing learning or planning for learning progression. Both planning for learning and predicting the *intended* learning, albeit in general terms, is made easier when the *ELOs* are interpreted as a learning progression, as clues to the *intended* learning are provided sequentially and possible predictions can be justified through each sequential image.

7.1.3 Study 2

This section compares the pre *LJCM* and the post *LJCM*, focusing upon the key findings from Study 1. By relating the ‘pre active’ and ‘inter active’ phases of the teaching-learning process, the relationship between the *intended* and *actual* learning is revealed and areas of concern highlighted, which will be discussed in detail in this section.

Comparison between pre and post LJCM

The pre *LJCM* allowed the researcher to consider the learning progress associated with the proposed learning journey. The researcher expected to see learning journeys that were governed by the *ILS*, providing students the opportunities to develop the stated skills, knowledge and/or understanding and providing the requisite evidence of learning and learning progress. The *translation* of the seven lesson plans into pre *LJCM* (see Chapter Six, pp. 165-220) allowed the intended learning journey to be analysed more effectively. The process of translation and the graphic representation of the lesson plan into a pre *LJCM* proved beneficial in terms of establishing the learning progression and highlighting potential problems with the learning journey relatively early on in the teaching-learning process. The development of the *LJCM* proved extremely beneficial to the researcher and the focus of this research study and has potential benefits in the 'pre active' phase for both teachers and learners.

The findings from Study 2 support the findings from research Study 1. The *ILS* provided a focus when assessing the pre *LJCM* in terms of teaching strategies and learning opportunities relative to the *ILS*. 'Teacher-led' discussions and demonstrations dominated the planned learning journeys, with 16 episodes evident in the seven lesson plans. Study 2 supported the findings from Study 1, in that the details accompanying the planned whole class demonstrations were often limited. The *actual* learning that took place during these demonstrations tended to be procedural in nature, in as much as the students could (with a little support from each other) replicate the process the teacher had demonstrated. Closed-questioning techniques, such as 'what is this called…' or 'would it be better if …' were typical. Engagement was low and several students during the whole class demonstrations were not able to clearly observe the entire demonstration, becoming disengaged and demotivated during the teaching episode. Practical activities tended to follow teacher demonstrations and represented the longest time allocation in the lessons observed.

Formative assessment activities were generally well planned into the learning journeys, with six of the lessons involving at least one formative assessment episode. The majority of the formative assessment strategies involved 'peer' or 'self-' assessment activities. Whilst observing the lessons, it became apparent that the number of planned formative assessment activities significantly reduced in the 'inter active' phase. Twelve formative episodes were planned into the seven lesson plans and this was reduced to eight episodes during Study 2. Teachers tended to ignore the formative assessment activity, as a result from either a perceived or actual lack of time during the lesson. The value of formative assessment, for both the teacher and the learner, has been widely discussed in current formative assessment literature (see section 4.8, p. 103). Neglecting the formative assessment episode may indicate teachers are placing a lesser value in terms of learning on this particular episode. The majority of the lesson plans ended with a formative assessment activity, typical designed as a plenary activity.

The learning journeys observed by the researcher generated between three and four *ELOs*. Whilst 'teacher-led' episodes such as 'teacher talk' or 'class discussions' infrequently produced an *ELO*, they were allocated a large proportion of lesson time. Effective 'class discussions' could have supported the learning focus and contribute to *ELOs* later in the lesson. However, as English, Hargreaves and Hislam (2002) contend, 'class discussions' vary in both the engagement of the students and the 'control' of the teacher, both of which could influence the quality of the *ELO*. During two observations it was difficult to collect *ELOs* produced by individual students (see School G lesson observation 3, p. 184, and School A lesson observation 2, p. 183), which raises issues in relation to group work and learning outcomes. The majority of *ELOs* produced by the students and gathered by the researcher took either a written or drawn form, usually evident in individual student 'theory books' or a practical form as a result of a practical activity.

The majority of learning demonstrated in the Design and Technology lessons could be classified as either knowledge-based or practical skills, producing learning outcomes that were either written, sketched/drawn or produced from a practical activity. Study 1 provides evidence of a narrow range of forms of Design and Technology learning outcomes. In this regard, there have been several calls for an increase in the variety of learning outcomes in order to represent more fully the range of learning evident in schools (Daugherty et al., 2011; QCDA, 2010).

7.1.3 Study 3

The main focus of Study 3 was whether or not *ELOs* demonstrated the *intended* learning, considered from both the teacher and learner perspectives.

Study 3 revealed that teachers were successful at identifying and describing, in general terms, the learning demonstrated by *ELOs*. General statements of learning included 'understanding press forming' or 'evaluation of practical work'. It was considered that, if the *ELOs* clearly demonstrated the *intended* learning, teachers would be able to predict the *ILS* using precise and specific learning statements. Where *ILS* were not fully formulated, the researcher presumed a lack of consensus between the focus group members, concluding that the *ELOs* did not clearly demonstrate learning and that the *ILS* were 'hard' to predict. The teacher experiences, beliefs and values about Design and Technology were evident in several of the teacher responses (see Appendix P).

Evidence that learning has taken place during a lesson is essential for effective teaching and demonstrating learning progress. Several *ELOs* lost clarity in terms of demonstrating learning once removed from the teaching-learning context; for example, School C, Lesson observation 7, and raised issues with the role of learning outcomes in the process of standardisation and moderation of learning used in departments.

7.2 Part two

7.2.1 Answering the research questions

The relationship between the *intended* learning and the *actual* learning in secondary Design and

Technology lessons provides the focus for this research study. The four research questions are central to this research:

- To what extent does Design and Technology teachers' planning achieve the *intended* learning outcomes?
- To what extent do the *intended* learning statements enable the *intended* learning to be achieved?
- What methods are used to reveal and gather evidence of students' learning in Design and Technology?
- Does the evidence of learning produced in Design and Technology lessons demonstrate the *intended* learning?

The following section considers the answers to each of these research questions.

1. To what extent does Design and Technology teachers' planning achieve the *intended* learning outcomes?

Based on the evidence of this research study question 1 requires adapting. Initially the planning process was considered to be the focus for this study and this question aimed to answer the extent that teachers' planning, including the processes, tools and methods used allowed the *intended* learning outcomes to be achieved, thus highlighting specific issues in the planning phase that might be responsible for the *intended* learning outcomes being achieved or not. However, as discussed in Part three of this Chapter (p. 246) although there are potential issues that could be investigated further in the planning phase, the issues that contribute to the achievement of *intended* learning are far more complex and permeate throughout the teaching-learning process. A more suitable question would consequently be,

Do the planning processes used by Design and Technology teachers support the production of

the *intended* learning outcomes?

The following discussion is based upon the adapted research question 1.

Design and Technology teachers have a range of planning processes that generally support the production of the *intended* learning outcome. Generally, teachers used an *informal* planning process to plan learning experiences (Calderhead, 1996), with Design and Technology teachers tending to use a number of *informal* approaches, such as presentation software, dialogue with colleagues, or sketches. *Informal* planning processes require a creative element, accompanied by a strong knowledge base and a degree of flexibility, and need to occur within a practical and ideological context (Calderhead, 1996). From a Design and Technology perspective, a degree of creativity inherent within the *informal* planning process was imperative, and this was evident in the methods teachers used to plan, both the design of resources and the planned teaching strategies, with ideas and motivation for learning opportunities being gathered from a wide range of sources, for example existing products, new technologies and current trends.

The *informal* planning process tends to have no formal structure in terms of time, place, process or procedures, in as much as the teacher does not sit down for a given time and plan. In reality, planning is a far more transient and dynamic process (Mutton et al., 2011). Of the 30 teachers involved in the survey, all focused upon describing 'personal' *informal* planning processes, irrespective of the more *formal* procedures required by their school. Such 'personal' *informal* planning processes which were both specific and bespoke to a particular context, for example the needs of a particular class, (see School F, Lesson observation 1, p. 182). As such, these *informal* planning processes were both adaptable and flexible.

Whilst teachers appeared to be competent in the use of both *informal* and *formal* planning approaches and were able to utilise each approach if and when appropriate, or deemed necessary; their rationale for using either approach was often unclear. Study 1 revealed that teachers associated much of the *formal* planning procedures to managerial purposes, for example when being observed, and indicated that less experienced teachers tended to gravitate to the 'dominant' *formal* planning procedures. More experienced teachers, however, relied on *informal* planning processes (see Appendix P), trusting their own judgements and exercising a degree of autonomy when planning (Hussey and Smith, 2008).

Typically planning processes involved an *informal* planning phase followed by a *formal* planning phase, dominated by the standardised whole school pro forma providing a conclusion to the entire planning process. Teachers appeared to combine elements of both *informal* and *formal* approaches when planning; for example, the use of PowerPoint slides allowed teachers a degree of flexibility and creativity in terms of designing the learning journey, and an opportunity to integrate the more *formal* aspects of planning, such as precise *ILS* and pre-determined learning outcomes.

By analysing both the *formal* and the *informal* planning approach, the formalisation of learning into *ILS* can be considered and compared. The specification of *intended* learning in precise terms is a prerequisite of the *formal* planning approach, with *ILS* normally restricted to a single sentence, identifying the *intended* learning and providing an indication of how it is to be measured (John, 2006). The *ILS* governs the *formal* planning process (Tsui, 2003), with constructive alignment between the teaching, learning and assessment providing the focus of the planning document (Hussey and Smith, 2008). In contrast, the *informal* planning approach involves cognitive processes (Biggs and Tang, 2011), which do not lend themselves to clearly pre-specifying learning intentions. Study 1, part 1 found a 'vague' awareness of the learning intention guiding the *informal* planning process; as such, the learning journey and learning outcomes were 'vague' in terms of detail, focus and purpose.

The *informal* planning approach was incompatible with direct referencing to the National Curriculum key concepts, key processes, or attainment levels (see Appendices B and C). Indeed, it can be assumed that such a ‘vague’ notion of the learning intention associated with *informal* planning is based upon the teachers’ current beliefs, assumptions and values regarding the subject (Lacey, 1977; Tabachnik and Zeichner, 1984). As discussed in Chapter Three, the key constructs that underpin a Programme of Study, such as the Key Stage 3 curriculum, must be sufficiently articulated in order for both teachers and students to interpret them (TLRP, 2009). Presumably, if the key concepts for Design and Technology have been effectively articulated, the ‘vague’ notion of learning could be referred to the key concepts.

Study 2 focused upon the *formal* planning process and therefore the comparison between the two approaches could not be extended into the ‘inter active’ learning phase, such a research focus would form an interesting complement to this research study.

The *informal* planning approach used by the majority of teachers for most of their planning tended not to be discussed; presumably, contributing to teachers’ lack of articulation in relation to their *informal* approach. *Informal* planning approaches appeared to be somewhat insensible, supporting the rapidity and immediacy of the teacher’s interaction with students in the classroom rather than the rational-purposeful thinking associated with problem solving and decision-making (Yinger, 1978). Furthermore, *informal* planning approaches did not appear to be particularly subject-specific, although planning models that support the teaching and learning of Design and Technology require further research.

Planning, Preparation and Assessment (PPA) is time set aside for teachers in England during their timetabled teaching day to allow them to carry out planning, preparation and assessment activities. With effect from 1 September 2005, all teachers with timetabled teaching commitments have a contractual entitlement to a minimum of 10% of their timetabled teaching time as PPA time (DfES, 2005). In practice, this equates to approximately two and half hours a week to plan lessons, prepare resources and assess students’ learning. The planning process used by teachers therefore has to be relatively simple, quick, time-efficient and effective (Budd and Earley, 2004).

2. To what extent do the *intended* learning statements enable the *intended* learning to be achieved?

This research study assumes that the purpose of the *ILS* is to identify the *intended* learning and provide an indication of the assessment of that learning (Kelly, 2013; Swaffield, 2009). Guidelines on formulating an *ILS* are briefly provided in the Key Stage 3 National Strategy on structuring learning, which states that 'designing a lesson follows the same process as other design projects. It starts with a clear understanding of the purpose' (DfES, 2004b: 2). However, the perceived purpose of *ILS* is not clear from the findings of research Studies 1 or 2, with the range of different formats, structural anatomies and elements incorporated into the *ILS* indicating confusion as to the purpose and function of the learning statement.

The guidance from the Department for Education and Skills (DfES, 2004b: 7) states that, 'defining the learning intention and ensuring that it is *precise enough* is an essential element of any good lesson design'. However, Study 1 demonstrated that writing succinct statements that describe learning is far from easy (Pring, 2000; Hussey and Smith, 2008; Waters, 2013b). The degree of precision and clarity when formulating and/or writing *ILS* was not considered by the participating teachers; however, all teachers used *ILS,* to provide the learning focus for the planning process. The standard approach when formulating the learning sentence was to use a sentence stem, typically relating to developing knowledge, skills or understanding. Once the sentence stem had been identified and written, the remaining structural composition of the *ILS* varied, demonstrating no 'standardised' or 'typical' sentence anatomy.

In theory, the more precise and clear a learning statement, the easier the learning can be demonstrated by the student and planned and identified by the teacher; and, as Clarke (2005) contends, the easier the learning can be assessed, thus addressing the requirements of an outcome-based education system. Clear specification of the learning intention benefits both the teacher and the learner (Wilson and Black, 2007). Students learn more effectively when they know exactly what they are supposed to be learning and why that learning is important to them, and teachers teach more effectively when they have the same information (Marzano, 2003; Moreland, 2008). Generally, Design and Technology *ILS* identified learning that was atomised, or simplified and isolated through discreet learning episodes (Moreland and Jones, 2000). By atomising learning and learning activities teachers are able to manage the planning for learning and evidencing and assessing learning more effective. Study 1 identified that such atomised *ILS* often lacked both relevance and challenge (Torrance, 2007). By atomising both teaching and learning, the relationship between the *intended* and *actual* learning is simplified and easier to achieve, as seen in the *ELOs* produced for Study 3; which revealed learning associated with each episodes in the learning journey and often demonstrated learning that was restricted in scope for assessment opportunities (Hussey and Smith, 2008).

Approaches to writing the *ILS* varied within departments and across schools. For example, over two thirds of the *ILS* did not identify the form the learning could take for assessment purposes, suggesting that the perceived purpose of the *ILS* was not consistent amongst teachers. Formulating a learning sentence requires the teacher to be clear in regard to the specific nature of the *intended* learning and how the learning can be demonstrated and assessed (Swaffield, 2009); therefore, the teacher requires a good knowledge of the pedagogical framework from which the learning is located. Indeed, in order to achieve clarity in regard to the learning outcomes, a comprehensive understanding of the key concepts that underpin the subject is required (Daugherty et al., 2011). This, however, presumes that the teacher's views and beliefs regarding the subject align to the pedagogical framework set down in the 2007 National Curriculum framework. This presumption was not evident in the *ILS* analysed in Study 1, which indicated that, although the key processes were evident in the *ILS,* the learning statements were not directly or indirectly associated with the key concepts.

The TLRP (2009: 3) findings suggested a less formulated approach to planning, stating '*intended* learning outcomes are best viewed as indicative of the educational goals'. They go on to say, in relation to assessing outcomes, 'the alignment is better understood with the ultimate goal being a synergy of curriculum, pedagogy and assessment' (James and Pollard, 2012: 28). A 'synergy' between teaching and learning indicates a less formal relationship between teaching and learning, and *ILS* need not be so specific or prescriptive. This approach aligns more to the *informal* planning process and supports the use of *ELOs* and formative assessment in the classroom in order to ensure learning is progressing. In this circumstance, the teacher is unable to rely on the current tightly 'controlled' teaching-learning process to define the relationship between *ILS* and *ELOs*.

3. What methods are used to reveal and gather evidence of students' learning in Design and Technology?

There was no evidence to suggest that teachers considered a range of appropriate methods to demonstrate, reveal, capture or gather *ELOs* or learning outcomes. Indeed, the majority of participating teachers did not consider or even identify with the notion of revealing, capturing, and/or gathering learning. The identification or indication of possible learning outcomes, as part of the *ILS,* was not standardised practice, and the use of DfES (2004c) guidance on the production of learning outcomes in relation to every episode was not evident.

The form the learning outcome took was not a consideration in the planning process, and appeared to be merely the 'by-product' of an activity (Tsui, 2002). In all cases, the learning activity provided the learning opportunity, and was the key consideration when planning the learning journey. Whilst McLeod (cited in Clark and Peterson, 1986) found that teachers thought more about *ILS* in the 'inter active' phase than in the 'pre active' phase of the teaching-learning process, this was not evident during the observations in Study 2.

Revealing the learning, or 'the process of seeking' evidence of learning, is the first stage in the formative assessment process (Broadfoot et al., 2002: 2–3). Whilst formative assessment activities were planned into the learning journey, there was no evidence that teachers were identifying suitable methods to reveal the *intended* learning or address the *ILS*. The range of formative assessment strategies used to reveal learning was narrow, with 'peer' and 'self' assessments common across all lesson plans and tending to form the 'review' or 'plenary' of the lesson (Sondergeld, 2010).

The relation between formative assessment and learning outcomes was not clear in either Study 1 or 2. Whilst there have been numerous attempts to connect learning outcomes with assessment (Gagne, 1974; Ing, 1978; Biggs, 1999; Jackson, 2000; Entwistle, 2005), in practice, teachers participated in this research study, planned for distinct formative assessment episodes. Theoretically, capturing and/or gathering the *ELOs* provided formative assessment opportunities, allowing the learning to be revealed and reviewed along the *intended* journey. However, the *ELOs* were not used for this purpose. The learning activity tended to be the vehicle for learning; the formative assessment activity produced formative feedback on the learning and tended to be distinct from the production of *ELOs*.

The methods of revealing the learning related directly to the activity the teacher had designed the student to do during the learning journey. Indeed, learning outcomes were generally associated with either 'designing' or 'making' activities or a stage of the design process and, thus, were considered 'typical' Design and Technology learning outcomes by the researcher (see Part three, p. 246 for full explanation of 'typical' learning outcomes). The typical method of gathering learning was through worksheet-based activities, with the worksheet capturing the learning in a form that could be gathered, thus becoming the learning outcome for that activity. Although several of the worksheet-based *ELOs* collected throughout the lessons clearly provided some evidence of learning, they often did not demonstrate the specific learning identified and described in the *ILS*.

4. Does the evidence of learning produced in Design and Technology lessons demonstrate the *intended* learning?

Question 4 was more complex than was originally assumed and raises several important epistemological questions involving the demonstration and assessment of students' learning (James, 2008), as well as whether the methods or processes used to demonstrate and assess students learning are valid and reliable. Due to the unforeseen complexities inherent in the question, the findings from Study 3 appear somewhat simplistic and shallow, and generalisations are difficult; however, they do supplement the findings from Studies 1 and 2 and, therefore, are significant when considered in relation to the main research question.

This research study revealed that Design and Technology teachers were able to predict, in broad and general terms, the *ILS* from the *ELOs*, thus supporting the contention that learning outcomes cannot be precisely predicted (Hussey and Smith, 2008). In this regard, learning outcomes are seen as indicators of the intentions of the teacher to be used as predictions of how the learning could be demonstrated and not as rigid or precise learning goals (TLRP, 2009). If seen as indicators of *intended* learning, the role and purpose learning outcomes in the learning journey become more meaningful and realistic in the teaching-learning process, thus acting as guides, not directives. Such findings complement the i*nformal* planning approach, where teachers could articulate a 'vague' notion of the learning associated with the learning journey and the learning outcomes, and create a tension with the formal requirement for planning.

The nature of the relationship between the learning outcome and the *ILS,* when the *intended* learning has only been identified in general and broad terms, raises the question 'how broad and/or general is acceptable as a prediction of learning?' That is, at what point does a general or broad prediction of learning cease to be useful to the teacher or student? Figure 6.27 (p. 200), for example, demonstrates students being able to use the sewing machine safely and accurately, and was predicted by all of the teachers' focus groups in Study 3. Whilst such a general *ILS* was clearly demonstrated by the *ELOs*, all the students in the group, irrespective of ability, demonstrated it. Furthermore, such generality only requires a simple yes or no in terms of assessment; that is, 'yes (or no) students were (not) able to use the sewing machine safely and accurately'. By stipulating too general or broad statements about learning, learning was reduced to a series of checklists or set of tick boxes (Kimbell, 1997). Learning was then rendered almost meaningless in relation to learning progression, but was relatively easy to plan for and consequently easy to assess.

Wilson and Black's (2007) contention, that the more tightly prescribed a pedagogical framework, the more helpful to teachers and learners, setting out a detailed sequence of progression, removing ambiguity, and reducing misinterpretation, particularly for non-specialists or inexperienced teachers, may indeed be theoretically correct. In practice however, the benefits of a tightly prescribed approach to planning teaching and learning and are not supported by this research study.

7.3 Part three

7.3.1 Discussing the issues

In theory, the relationship between the *ILS* and the learning outcome should be clear and straightforward: the *ILS* predicts the learning that will take place in the lesson, while the learning outcome demonstrates the *intended* learning. The *intended* learning identified from the National Curriculum is converted into an *ILS*, providing the focus for the learning outcome; the learning outcome theoretically demonstrates the *actual* learning and learning progress that takes place during a learning journey. This research study raises several concerns regarding the conceptualisation of a learning outcome and, in particular, how learning outcomes are operationalised and employed within the teaching-learning process. These issues are particularly relevant to Design and Technology education due to the complexities inherent in both the nature and scope of the subject and will be discussed in greater detail in the next sections.

7.3.2 The role of the learning outcome in the teaching-learning process

There seems to be a lack of clarity around the precise meaning and application of learning outcomes in relation to teachers' day-to-day practice, as was evident throughout the teaching-learning processes observed in this research study. The ways in which teachers used the term 'learning outcome' varied significantly, with examples of learning outcomes being used in conjunction with *ILS*, instead of *ILS,* or not used at all in the 'pre active' phase (Harden, 2002). As a result of differing perceptions of what learning outcomes are and their purpose within the teaching-learning process in secondary school contexts, teachers appeared to be confused about what was required in terms of learning outcomes. However, most telling was the total lack of application of learning outcomes within teachers' *informal* planning processes. This is particularly relevant given these processes are 'designed', 'owned' and managed entirely by the teachers.

Misunderstandings in relation to the role of a learning outcome can be attributed to several factors, which will be discussed in turn below.

- ***An outcome-based approach to education***

This research study found that the current Outcome-Based Education (OBE) system is being used for auditing and monitoring purposes and not, as originally intended, to provide clarity of the learning expectation, teacher flexibility, student involvement and comparability in relation to learning progress (Biggs, 2003). Shifting the focus from teaching and learning, to auditing and monitoring teaching and learning, creates a distinct transformation as to how OBE systems are perceived and engaged by the teaching profession (Hussey and Smith, 2008). Within this study, the perception of an OBE approach as an auditing and monitoring framework is exemplified throughout the teaching-learning process, from the use of planning pro formas to the implementation of learning outcomes into classroom practices.

In a context where teachers are required to specify learning identified from a prescriptive pedagogical framework and follow pre-specified formulaic teaching instructions, in order to provide 'evidence of learning' in their classrooms, the role of the learning outcome is not fully 'embraced' or understood by the teaching profession (see Pring, 2000). In this regard, the current misuse of the OBE system has created confusion around the precise role of learning outcomes within day-to-day practice, and is hardly conducive to teachers embedding the concept of a learning outcome effectively in their classrooms.

- ***The relationship between intended learning and learning outcomes***

Another potential source of confusion involves how *ILS* and learning outcomes are related. Given that the distinction and relationship between the *intended* learning and the learning outcome is neither clear nor precise, the confusion surrounding the role of learning outcomes is compounded. Whilst it may be assumed that the formulation of the *intended* learning involves consideration of the learning outcome, teachers neglected to identify the details of learning outcomes; for example, the form, the methods of gathering and capturing, and the assessment strategies in their planning. Contrary to the assertions made in the Key Stage 3 National Strategy guidance documentation (DfES, 2004a), the *ELOs* added no particular value to the teaching and learning episodes, or to the overall learning journeys, as observed in Study 2. This is not to say that the *ELOs* could not be assessed and/or used in subsequent learning journeys in a formative assessment capacity, but this was not evident from this research. In fact, it was clear from the research study findings that learning outcomes were not effectively operationalised into pedagogical practices (Atherton, 2013).

If we are to accept that teachers can predict *classroom-based learning* by clearly identifying, defining, describing, and formulating it into a single sentence (see James, 2008), we must also accept that *classroom-based learning* involves a relatively narrow band on the 'continuum of learning', as only certain types of learning are suitable for formulating into single sentences. Furthermore, the demonstration of *intended* learning, by definition, has to involve a physical form or physical outcome (Kimbell, 2008). Typically, Design and Technology learning outcomes are 'products' or 'by-products' of learning activities, to be used in the teaching-learning process, as or when the teacher considers it necessary (Adam, 2004). The teacher's focus is on planning the learning activity and the students' focus is on undertaking that activity, while neither have a focus upon the learning outcome; thus, the *ILS* tended to focus on the activity that would produce the learning and not on the demonstration of the learning intended to take place. In this regard, the *ILS* often lacked an application of the knowledge, skills and understanding associated with Design and Technology and, consequently, only provided students the opportunity to develop, for instance procedural knowledge.

Misunderstandings in relation to the role and function of the learning outcome in providing evidence of a range of learning forms was evident in the narrow range of learning outcomes planned by the teachers and produced by the students (TLRP, 2009). It can be presumed that, unless the teacher understands the value of learning outcomes within the learning journey and is *actively* considering and planning for learning outcomes, the production of learning outcomes will remain within a narrow range. Certainly, the learning outcomes captured and gathered during Study 2 demonstrated a limited learning range (Study 3 findings, section 6.5, pp. 207-220). If, indeed, it is the learning activity that produces the 'learning by-product', more focus needs to be placed upon planning a greater range of learning activities in order to increase the range of learning outcomes for each lesson, rather than placing the focus on the learning outcome itself. However, such a change in focus is unlikely to reduce the confusion regarding the role and function of learning outcomes; in fact, a third aspect, that is the learning activity itself, may well confuse the situation further.

The narrow range of learning outcomes seen in this research study, and in secondary schools in general (Daugherty et al., 2011) is associated with the narrow range of learning considered important in secondary education (James, 2005). With reference to the 'continuum of learning' (section 2.3, p. 27), learning can be classified in a variety of forms and types, ranging from 'informal' to 'formal', with educational institutions tending to focus on a particularly small range of learning capable of being assessed. Learning that is neither visible (Hallgarten, 2014) nor immediate (Nuthall, 2011) is not easy to measure and considered unsuitable as 'evidence of learning'; thus, *classroom-based learning* outcomes rely on performance evidence (Soderstrom and Bjork, 2014).

The distinction between performance and learning is complex when considered in terms of learning outcomes, not least because performance evidence can demonstrate learning, and learning evidence can be in the form of performances. Bjork (1999) insists the main distinction between learning and performance can be seen in classrooms during a teaching episode, when learning tends to be inferred at some point after the teaching episode; in contrast, performance can be observed and measured during the teaching-learning episode. This distinction further supports the use of performance evidence in relation to *classroom-based learning*.

The *ELOs* captured and gathered during Study 2 are considered performance evidence, in as much as they were the result of a teaching-learning episode (Soderstrom and Bjork, 2011). As performance is often observable during the lesson, it can be used for formative assessment purposes. As stated above, learning is inferred and measured at some point after the teaching episodes and, therefore, it is difficult, if not impossible, to capture, gather, and to plan, for the assessment of learning. Whilst relying upon performance indicators or performance evidence in secondary schools clearly minimises the range of learning outcomes produced, focus on performance rather than learning would provide a greater degree of clarity in relation to assessing students' attainment.

- ***The conceptualisation of learning outcomes***

The concept of an *ELO* was taken directly from the National Strategy materials; although no clear definition of an *ELO* is given, the National Strategy materials do indicate teachers' need to consider both the quality and quantity of the 'product' (DfES, 2004b: 7). The researcher has strengthened the definition by specifying the requirements of tangibility and visibility, thus accessibility and assessibility. It is important to highlight the discussion presented in Chapter Two on 'situated cognition' (p.20) regarding the view that learning is 'situated' (Anderson and Anderson, 2005), rather than concerned with the acquisition of particular forms of knowledge. Situated learning theorists argue that whatever way we choose to define learning outcomes, they cannot be separated from the learning experiences that produced them, such as the nature of the learning environment. However Study 3 involved removing and thus displacing the *ELOs* from the learning context they had been produced. It was originally considered Key Stage 3 students would be able to identify either some aspect of the learning or a degree of the learning being demonstrated in the images of the *ELOs*, although the researcher was unsure to what degree or extent the students would be able to do this. The findings highlight the difficulty of identifying learning when the context has been removed and reinforces the importance of context when identifying possible learning from *ELOs.* The student's focus group did not provide important data however it may have been more useful if the same students who produced the *ELOs* had been asked to identify the learning after a specified duration.

The fundamental question of whether *classroom-based learning* can ever be predicted and then demonstrated further complicates the use of learning outcomes (James, 2008). The findings from this research study indicate that the identification of learning outcomes and the concept of demonstrating the *intended* learning are both problematic for teachers in their day-to-day practice. The notion of prescribing learning outcomes constrained by time and resources, with the intention that every student produce the same learning outcome, is in conflict with current learning theories (Illeris, 2009) and recent research into school-based learning (Chapter Two, pp. 8-42). Although the *ELOs* gathered in Study 3 are limited, in that they are produced from one student per observation, and therefore do not represent the degree of learning within the entire class, the form the actual learning outcome takes, whilst designed specifically by the teacher, tends to be standardised, for example worksheets or practical outcomes. Such standardisation of the *intended* learning outcomes produced in a class requires a tightly prescribed and focused learning journey that is 'controlled' entirely by the teacher; therefore, the range of learning demonstrated by the learning outcome is limited (see Figure 4.1, p. 109). Indeed, such a behaviourist approach to teaching ensures the teacher dictates what knowledge the learners will learn, in what order they will learn it, and how it is to be learnt; as such, learning outcomes become predictable (Kennedy, 2007). Students are expected to demonstrate the *intended* learning outcomes and have little or no scope to shape, negotiate or deviate from them. During none of the observations in Study 2 were students given the opportunities to demonstrate their learning in a form that they identified as most appropriate for them. Indeed, the concept of emerging learning outcomes was not evident in any of the observations (Hussey and Smith, 2008). Furthermore, in Studies 1 or 2, none of the *intended* learning journeys could be described as 'open-ended' or even 'authentic', as the learning outcomes were pre-determined by the teacher. This approach underpins the role of the student as a mechanical agent who will react to the contexts and information given to him/her (Dann, 2002: 12-13) and conflicts with the notion of a 'self-regulating' learner (Hewitt, 2008).

Whilst within any one class there is a range of abilities requiring different teaching-learning processes, tightly specified, predetermined *ILS* can only ever be targeted at a general learning populous. Planning for learning and, particularly, learning outcomes requires the teacher to address and focus upon a 'collective view' of learners' existing knowledge, skills and capabilities (Kimbell, 2007b: 250) and thus can rarely cater for the individual. The practicalities of classroom teaching and learning require teachers to provide a balance between individual and whole class. Indeed, for several members of a class, the tightly specified *ILS* may not be entirely applicable as a learning focus and, therefore, will not produce a suitable *intended* learning outcome. A broad learning statement would help overcome this situation.

- ***Learning outcomes and formative assessment***

The role and operationalisation of formative assessment can also be seen to compound the confusion surrounding the implementation of learning outcomes into teachers' practices. A similar misunderstanding in relation to the role of learning outcomes is the relationship between learning outcomes or *ELOs* and formative assessment (Adam, 2004). It was presumed that teachers would use learning outcomes as formative assessment mechanisms within the learning journey; however, this was not the case.

The function of formative assessment is not fully established by teachers within the teaching-learning process and, consequently, teachers' implementation of formative assessment is weak (Ofsted, 2008; Black and Wiliam, 1998; Dekker and Feijs, 2005). Whilst *formal* planning approaches ensure formative assessment opportunities are integrated into teaching and learning episodes, these episodes are omitted when teachers move from the 'pre active' to 'inter active' phases. Furthermore, formative assessment is not evident in *informal* planning approaches, suggesting teachers consider formative assessment episodes the least valuable element within the teaching-learning process. Whilst the formal lesson plans provide evidence that teachers are considering formative assessment, this research study found formative assessment was being implemented in rather a tokenistic way into the learning journey (Moreland et al., 2008), lacking specific details in terms of the formative assessment activity, limited in relation to the range of strategies used and often not addressing the nature of the *intended* learning.

Of particular significant to this research study was the lack of any modifications to the *intended* learning journey after formative assessment opportunities. Whilst the notion of a 'corridor of tolerance' or 'reflection-on-action' (McAlpine et al., 1999) or 'improvised' planning (Wiliam, 2009) during the 'inter active' phase suggests teachers are constantly responding to the teaching-learning environment and the needs of their students, this was not evident in any of the lessons observed in Study 2. Teachers used lesson plans not to guide, but to prescribe their lessons, rigidly adhering to the intended learning journey and dismissing any potential confusion or misunderstandings in relation to the *intended* learning; therefore, in this regard, formative assessment strategies within the teaching-learning process were useless.

Educational measurement involves four activities: designing opportunities to gather evidence, collecting evidence, interpreting it, and acting on interpretations. The formative assessment literature commits little attention to the third activity, that is 'interpreting evidence', in particular to the fundamental principles surrounding the connection of evidence – or what we observe– to the interpretations we make of it (Bennett, 2011). Bennett argues that formative assessment can be more principled, from a measurement perspective, by recognising that the characterisations of students are inferences and that, by their very nature, are uncertain and also subject to unintentional biases (Gladwell, 2006). Whilst learning outcomes are *intended* to demonstrate specific learning, they have been 'designed' to do so by the teacher with little or no scope for the student to input personal learning preferences or styles.

Furthermore, the standardised approach to learning outcomes, coupled with a strong inclination on behalf of the teacher to 'see' the *intended* learning, raises issues with validity and reliability when interpreting 'evidence of learning'.

7.3.3 Design and Technology teaching and learning

Design and Technology provides a unique contribution to the National Curriculum as it offers students opportunities to partake in technical, practical education, providing a creative experience and a capability for innovation (Morgan, Jones and Barlex, 2013). However, the subject appears to be *straight-jacketed* (Stenhouse, 1975) by the current education frameworks, policies, political priorities and agendas and the tightly specified curriculum objectives matched to prescribed standards (Swaffield, 2011). This research study reveals several aspects of the teaching-learning process that are restrained or restricted; such aspects will provide the focus of the discussion below.

Governed by an 'OBE-influenced' system, adherence by teachers to prescribed learning outcomes is not surprising (Handal and Herrington, 2003). However, for teachers to implement learning outcomes effectively, the concept of an 'outcome of learning' needs to align to their beliefs and values as a teacher and their beliefs surrounding what constitutes quality teaching and learning. Arguably, the current education context reduces the teacher role to that of 'compliant technician', whose job is largely to implement protocols and carry out instructions (Hallgarten, 2014: 12). Within such a climate, creativity and flexibility in relation to teachers' practices are often neglected (McLellan and Nicholl, 2008a).

- ***Learning outcomes and the current pedagogical framework***

Whilst the 2007 National Curriculum and, in particular, the Assessment for Learning Strategy aimed to ensure learners got 'the support they need to be motivated, independent learners on an ambitious trajectory of improvement' (DCSF, 2008: 4), the learning journeys analysed in studies 1 and 2 were dominated by a teacher-led focus, with teacher-led discussions, 'teacher-talk' and demonstrations led by the teacher prevalent. This research study demonstrates that the teacher in the Design and Technology classroom has complete 'control' of the learning throughout the learning journey. A fundamental issue in the 'product-orientated curriculum' or an OBE approach is that of 'control' (Fullan and Langworthy, 2014; Grundy (1987). This research study provided limited evidence to support a 'mixed authority' teaching-learning environment (Watts, 1998), where the ownership of learning lies with both the teacher and the student, with students actively involved and equal partners in the learning process, rather than passive recipients of knowledge transmitted or delivered by the teacher (Howard, McGee, Schwartz and Purcell, 2000).

Furthermore, there was limited evidence to suggest teachers were using constructivist approaches to planning teaching and learning episodes, an approach particularly suited to Design and Technology (Fox-Turnbull, 2010).

‘Teacher-control’ was further observed during the ‘inter active’ phases of the learning journeys and in relation to formative assessment activities, when feedback from the students on the *intended* learning was neither effectively gathered, nor acted upon, by the teacher. Thus, ‘improvised’ or ‘responsive’ planning requiring the teacher to be vigilant of the learning progression within the class and respond accordingly was not evident. Furthermore, ‘Just in Time’ learning (Martin, 2011) was not evident in any of the lesson observations, with the learning clearly being managed by the teacher in all instances. Lesson plans dictated the learning journeys, with teachers sticking closely to the pre-planned activities and learning outcomes. Indeed, it appeared that changes to the lesson structure or content might jeopardise the production of evidence of learning, required for auditing, monitoring and reporting purposes; thus, the ‘outputs’ would not be considered suitable.

The key concepts for Design and Technology underpin the 2007 pedagogical framework and, whilst, it could be expected that the key concepts would be revealed in the range of learning outcomes collected for Study 3, the translation of the 2007 key concepts was not evident in the *ILS*, learning opportunities and learning outcomes. Indeed, the key concepts were not mentioned in the lesson plans or in the teachers’ description of their *informal* planning models. Although general in nature, each of the four 2007 key concepts were presented with additional ‘sub concepts’, which were not evident in the teaching-learning process; thus, the key concepts were not seen to be embedded into teachers’ practices, either directly or indirectly. Although not the focus of this research study, explanation for this needs to be explored further; indeed, it can be argued the lack of operationalisation of the key concepts is due to either difficulties translating the key concepts into physical learning outcomes or teachers’ lack of acceptance and/or assimilation of the 2007 key concepts into practice (Daugherty et al., 2008).

The introduction of the Key Stage 3 National Strategy materials tackled the teaching of designing skills; it neglected to address the assessment of design thinking and decision-making skills required within the design development process. As discussed in Chapter Three (pp. 45-80), such cognitive skills do not produce performance evidence and are often difficult to access and, as such, are often not assessed by teachers (James, 2008). A lack of designing related learning outcomes was evident in Studies 1 and 2, combined with a significant lack of opportunities for students to develop their creative skills. The lack of design-based learning outcomes can be explained in relation to difficulties transforming designing skills, and the associated cognitive skills, into learning outcomes. The prescribed requirements of an 'OBE-influenced' teaching-learning process do not promote the production of less tangible or ambiguous learning outcomes. Arguably, teachers need support accessing and assessing cognitive skills (Kimbell, 2002).

- ***Design and Technology and 'typical' learning outcomes***

The learning outcomes produced during the Design and Technology learning journeys can be considered and described as 'typical' Key Stage 3 Design and Technology outcomes of learning. The use of the word 'typical' in relation to learning outcomes, in this research study can be justified, through the prevalence of practical-dominated, knowledge-based, content-focused, 'teacher-controlled' learning outcomes. Furthermore learning outcomes tended to demonstrate a single learning focus; learning outcomes were often isolated from the 'bigger picture'; and, there was a lack of creativity or authenticity. The researcher considered the learning outcomes analysed during this research study to be unoriginal and 'familiar'. These 'typical' aspects of Design and Technology learning outcomes will be discussed in detail below.

This research study found that Design and Technology learning outcomes involved demonstrating designing and making skills, with the majority of learning outcomes having a practical nature and were considered suitable as performance evidence of learning (Kimbell, 1994). Indeed, a significant percentage of learning journeys and *ELOs* were clearly associated with a practical activity. Furthermore, a strong focus on 'doing' in terms of planning, teaching, learning and assessment was evident (Ofsted, 2008). Although there are many types of learning involved in practical activities (McCutcheon, 1980), procedural skills associated with the particular practical activity were prevalent. Although scaffolding and modelling strategies were common within the learning journeys planned in Study 2 (see Figure 6.30, p. 203), the activities were based upon performing the skill or task and not on any associated understanding or knowledge. This is problematic for the subject, as it masks the learning associated with the 'doing', and tends to render it less significant to 'doing' (Kimbell, 2007a). It does not allow other learning forms or types the opportunity to be taught effectively.

Whilst a practical approach to Design and Technology is supported by an OBE system, in as much as it complements the *formal* planning model and produces manageable learning outcomes through practical learning activities, it does have serious implications for how the subject is both viewed and valued within the curriculum, and consequently on how the subject is perceived by teachers, parents and students.

Knowledge-based or attainment evidence was a typical category of learning demonstrated in the learning outcomes demonstrated in this research study and a learning form that is relatively easy to plan for and assess. Whilst such learning outcomes demonstrated the *intended* knowledge, whether the students had acquired this knowledge for longer than the duration of the production of the learning outcome was questionable (Nuthall, 2000). Furthermore, the teacher controlled the knowledge acquisition through structured pro formas or leading questions on worksheets. Learning types and learning outcomes that complement the current 'OBE-influenced' system are considered favourable by teachers and schools, explaining their dominance in Study 3.

As established throughout this research study, Design and Technology is task-orientated with a clear performance bias in relation to planning, teaching and assessing. Thus, learning outcomes tend to be performance-based and learning tends to be conceived in terms of performances (see Chapter Three, pp. 45-80). However, performance evidence, in terms of learning outcomes, cannot demonstrate the entire range of learning associated with Design and Technology education. Progressing students' learning in Design and Technology requires the interplay or application of knowledge, skills, understanding and processes (Moreland et al., 2008) and learning outcomes need to demonstrate this interplay and application. Learning outcomes tended to be one-dimensional inasmuch as it was focused upon one classification of learning, for example procedural or conceptual knowledge. Very few of the *intended* learning outcomes involved a multidimensional approach to learning or demonstrated interplay between, for instance, knowledge and skill.

Planning for learning outcomes that demonstrated 'knowing why', whilst rare, could have provided evidence of interplay between two or more learning forms; for example, a student's knowledge of why the plastic-forming process is used with certain plastics is dependent upon knowing the process and the characteristics of the particular plastic. By considering and planning for learning outcomes that demonstrate different knowledge forms or strands, isolated learning outcomes could be reduced, resulting in a more realistic, authentic learning outcome (Love, 2013).

In order to formulate *ILS* and ensure that the *intended* learning can be achieved in a lesson, learning was often atomised. Supported by the current 'OBE-influenced' system and the complementary 2007 National Curriculum, teachers are both familiar with, and efficient in the process of atomisation of learning. Indeed, as seen in example School C, lesson observation 6 (p.187), certain challenging concepts in Design and Technology require a reductionist approach to teaching and learning. However, there appeared to be a direct relationship between atomised learning and isolated learning opportunities, where students performed a task in isolation; for example, School G, lesson observation 4 (p. 185), where students produced an *ELO* on 'tonal scale' in a lesson, focused upon the process of 'press forming'. Furthermore, several *ELOs* collected from this research study demonstrated an isolation of learning types, as they demonstrated knowledge, skills, understanding, or processes (Moreland et al., 2008), with limited evidence of integration or connectivity (Narayan and Kumari, 2010). In this respect, learning journeys required students to either 'learn about' or 'learn to' rather than a coherent combination of both.

A further consequence of isolating the learning into single learning forms or types involves the production of learning outcomes in a rather piece-meal fashion, with one learning outcome following another, in sequence. As seen in the pre *LJCM* and post *LJCM,* this approach is typical in terms of Design and Technology teaching-learning processes (see Chapter Six, 176-236). Design and Technology is holistic by nature and requires the student to access the interconnections and interactions between the various stages. In this regard, Design and Technology learning outcomes need to be considered holistically in relation to the learning journey, and teachers need to consider positioning the learning outcomes at relevant points in the learning journey in order to capture authentic learning.

- ***Design and Technology and creativity***

The 2007 National Curriculum states that, 'In design and technology pupils combine practical and technological skills with creative thinking to design and make products and systems that meet human needs' (DCSF/QCA, 2007: 51). Creativity involves the *extended abstract* outcomes of learning (Biggs, 1999; 2003), such as hypothesising, reflecting, generating ideas, applying knowledge in new contexts or domains, and working with problems that do not have unique solutions. As Torrance (2007) discusses in relation to creativity, learning outcomes add value to the information given and are not just the replication of information. Thus, being creative involves complex or multidimensional learning in the sense that it is not about learning something determinate and that, unlike more controlled learning, the outcomes may not be predicted in advance. This is not to say that teachers cannot influence the development of creativity in their students. Teachers can create conditions under which complex learning is more likely to happen and can make general predictions about creativity amongst groups of students. However, complex learning can neither be planned for nor measured in the way that we treat less complex learning (Knight, 2002).

Davies, Jindal-Snape, Collier, Digby, Hay and Howe's (2014) systematic review of literature on promoting creativity in the classroom supports the importance of the following factors in *teaching* creative skills development in students: flexible use of space and time; availability of appropriate materials; working outside the classroom/school; 'playful' or 'games-based' approaches with a degree of learner autonomy; respectful relationships between teachers and learners; opportunities for peer collaboration; partnerships with outside agencies; awareness of learners' needs; and non-prescriptive planning. In this respect, the designing aspect of Design and Technology requires a different approach to planning by teachers, one that focuses more on creating the right context and environment rather than on the subject content.

The current education context does not allow creativity to flourish (Hallgarten, 2014). In relation to this study's findings, there were no examples where students were being asked to either apply or demonstrate their learning in a new context, or indeed any examples where creativity was a focus of the learning process. When the focus is firmly on the production of pre-specified learning outcomes, which satisfy the monitoring, auditing and reporting requirements of the school, teachers are sensible to ensure they deliver on time and to the necessary quality for each student (Nicholl and McLellan, 2008).

7.4 Key conclusions of research

This research study has provided extensive findings, some of which need further investigation, some of which have been demonstrated throughout this research study.

In order for teachers to provide opportunities for students to progress in Design and Technology *classroom-based* learning, it is crucial that teachers planning processes are both effective and appropriate to the nature of the learning. The findings from this research study suggest that a variety of planning processes suited to the range of Design and Technology learning, designed and developed by Design and Technology teachers is required.

By addressing issues around the ownership of planning processes in line with a constructivist paradigm, teachers would be permitted to be innovative and creative in their planning approaches. By allowing teachers to approach the planning process as a design task allowing a more authentic *design* environment, the role of the *ILS* and of *ELOs* in the teaching-learning process could be developed and the use of learning outcomes in relationship to the cognitive demands of Design and Technology can be explored by teachers.

The conclusions of this research study are of significant relevance to all teachers of Design & Technology, both nationally and internationally and will be discussed with reference to both these contexts in Chapter Eight.

Chapter Eight Conclusions and Recommendations

This chapter focuses on how the key findings translate into a classroom setting and, in particular, a Design and Technology environment. It was the original intention that the findings from this research study would be significant for teaching and learning practices, with the motivation being driven by a resultant impact in the classroom, which was both direct and real. It was hoped that the key findings could be presented as guidance for teachers on specific aspects of the teaching-learning process: to enable, for example, the planning process to be more manageable and effective, and thus supporting the teachers' day-to-day practice in a meaningful way.

The 'research-practice gap' – the problematic relationship between research in education and educational practice – has been widely reported in the literature (Carnine, 2009). Justifications for such a 'gap' are numerous, with discussions tending to revolve around three distinct differences: institutional, communicative, and philosophical differences between teaching practice and research practices (Ferguson, 2005). Norman (2013) argues that high-quality research into what works best can improve outcomes; but, within an educational context with such a strong political influence, becoming a truly 'evidence-based' profession is not easy, and teachers need to play a significant role in the transformation (Goldacre, 2013).

The first half of Chapter Eight locates this research study's findings within the current educational context and then translates the findings into the Design and Technology classroom, discussing possible issues and further developments. The second half comprises a more 'reflective' stance in relation to the research process as a whole and considers possible modifications for an improved research process.

8.1 The 2014 National Curriculum

A new curriculum in England was introduced in September 2014 (DfE, 2013a) and potentially offers opportunities for educational change. Acknowledging Government's prescription and direction of education through the National Curriculum over many years has resulted in both a 'de-skilled' and 'de-professionalised' teaching community (*The Children, Schools and Families (CSF) Committee Report*, 2009; Beck, 2008). *The Remit for the Review of the National Curriculum in England* (2012, par. 9) stated that its aim was to achieve a 'new approach' to the curriculum, one which would transform education by reducing 'prescription and to re-establishing teaching and learning as matters of professional expertise'.

Arguably, the 2014 revised curriculum is a reaction to the recent focus on how children learn as opposed to what they learn, which had been firmly on the education agenda for several years (Lambert, 2007). However the explicit focus has shifted and is now upon the product of learning and not the processes involved in learning; in this sense, it is 'learning-output' focused. After more than two decades of National Curriculum rewrites that have seen progressively more emphasis placed on pedagogy, learning skills and personalisation, there now seems to be a clear move back towards knowledge; that is, what students will actually learn during their time at school. As we have seen in this research study, a focus on knowledge and content in terms of teaching and learning complements and supports an OBE approach. Pedagogical guidance on how to deliver this *new approach* and establish a *cultural shift* in the classroom is limited. There exists a distinct contrast and possible conflict in approaches to teaching and learning, between the curriculum principles underlying the 2007 and the 2014 National Curriculums.

Whilst the 2014 National Curriculum is less prescriptive, the auditing and monitoring agenda is still prevalent and arguably dominates current educational frameworks (Morley and Rassool, 2014). Current research studies indicate that when Ofsted inspections are imminent, Head Teachers predominantly focus on the inspection framework and on improving their capacity-building and school organisation (Courtney, 2012; Baxter and Clarke, 2013; Jones and Tymms, 2014). Wolf and Janseens' (2007: 382) overview into the effects and side effects of control mechanisms in education concludes that an over-emphasis on the assessed elements or 'teaching to the test/inspection' as an undesirable side effect, with schools focus being placed on short-term solutions at the expense of the long-term policy'. A common focus in secondary schools involves teachers teaching to the test or to Ofsted inspection criteria, and Head Teachers narrowing the curriculum and teaching in order to meet the Ofsted framework (Jones and Tymms, 2014). In such a context, ensuring teachers experience a 'greater freedom to use their professionalism and expertise to help all students fulfil their potential' (DfE, 2013b: par. 1) is difficult to achieve.

Whilst the 2014 Programmes of Study are significantly slimmer than previous Programmes of Study, setting out the core knowledge, understanding and skills, they are more content-focused. The relationship between knowledge, skills, understanding and process has not been addressed, arguably leaving teachers confused. The Programmes of Study for Design and Technology have identified four key concepts, namely design, make, evaluate, and technical knowledge (DfE, 2013a). Students are expected to apply both knowledge and skills in these key areas to solve practical problems. The separation of designing and making into distinct activities, as seen in this research study, isolates learning in, and teaching and assessment of, Design and Technology, thus creating tension with the authentic, holistic approach required. However, two new approaches to designing are highlighted, namely *iterative* design and *user-centered* design. Both design approaches move away from the linear, prescriptive design process-led approach, to a more APU 'style' model, and both represent a more authentic, industry-led approach to design development, potentially providing teachers and students with greater flexibility and creativity in terms of the structural processes that support Design and Technology. The GCSE syllabi are in the consultation phase at the time of writing this thesis and it will be interesting to see if the emphasis of the design process has similarly been downgraded in this context.

- ***Classroom-based learning***

In order to formulate learning into *ILS* or even identify learning that 'guides' learning journeys, *classroom-based learning* needs to be defined. Indeed, *intended* learning and learning outcomes cannot fully be explored unless they are considered in relationship to *classroom-based learning.* A definition needs to locate *classroom-based learning* within the context of learning theories and views on learning in order for teachers to identify the learning that takes place in classrooms. Indeed, the teaching community would benefit from such a discussion and the role of schools and teachers as providers of learning opportunities.

Classroom-based learning, by definition, occurs within the given pedagogical framework. The pedagogical concepts presented to teachers in the National Curriculum 2007, for example *ILS* and *ELOs,* were intended to support teaching and learning, rather than dictate practice. Thus, such pedagogical concepts have to be considered in relation to particular contextual requirements, whether that is school contexts, subject requirements, class needs or teacher preferences. The processes of adopting, adapting or discarding such pedagogical concepts has to belong to the teacher and the teaching community. As this research study findings have demonstrated, whilst aspects of the National Strategy materials have been embedded into teacher practice, for example, the use of episodes, there has been no evidence to suggest that *ELOs* are a useful aid within the teaching-learning process. The process of accepting or rejecting aspects of Government guidance and support on pedagogical issues appears to have been neither an intended nor conscious decision by the teaching community. A cultural shift is needed to ensure teachers explore, discuss and adapt current pedagogical developments in a purposeful manner, identifying what works for them, their discipline and their students. By exploring support materials on teaching practice as action researchers, a more theory-practice problem-solving approach can be developed. The 'freedom' promoted in the New National Curriculum could provide teachers with this opportunity.

- ***Planning processes and procedures***

The revised Ofsted School Inspection Framework (Ofsted, 2014b: 16) states, ‘inspectors will not expect teachers to prepare lesson plans for the inspection’. Rather, inspectors will use the evidence gathered from lesson observations to help judge the overall quality of the school’s curriculum. Whilst this permits a greater flexibility in relation to subject-specific planning processes and procedures, the need for teachers and students to ‘evidence learning’ and capture and gather learning outcomes throughout the lesson has not been removed. The struggle by teachers to effectively translate and implement Government policy into their daily practices can be highlighted throughout the teaching-learning process (McCluskey, 2007). However, such tensions are now never clearer than in the planning stages of the teaching-learning process (Hussey and Smith, 2003: 358).

Arguably any process represented as a framework or model becomes formulised and formalised; the Design and Technology design process has become synonymous with the linear, stage-by-stage, prescriptive model for both teachers and students. Currently, teachers’ *informal* and *formal* planning processes are influenced by an objective-led, outcome-based designed pro forma. The dominant approach to planning has restricted both teaching and learning, thus alternative models or approaches to planning Design and Technology teaching and learning are required.

Various models for Design and Technology have been developed, emphasising and/or reinforcing certain aspects or concepts of the subject and potentially providing the focus for a variety of planning processes. Morgan, Jones and Barlex’s (2013: 4) approach involves the notion of ‘a Design and Technology Toolbox’ (see Appendix W). This approach splits Design and Technology into four groups: design, technology, critique and data. A series of key concepts and principles is associated with each group and aims to provide a coherent curriculum for Design and Technology, which involves an integrated understanding of the key concepts across all material areas. Barlex and Rutland (2004) introduced the ‘design decisions pentagon’, a conceptual model designed to develop insights into the requirements of teaching designing (see Appendix V). The model involved five conceptual considerations: conceptual; marketing; technical; constructional; and aesthetic (Rutland, 2009; Barlex and Rutland, 2004). Moreland’s (2008) primary planning tool focused on the multidimensionality of Design and Technology, providing teachers with the opportunity to consider conceptual learning outcomes, procedural learning outcomes, societal learning outcomes and technical learning outcomes during the planning process (see Appendix U).

By providing or developing alternative teaching and learning frameworks for Design and Technology pedagogy, teachers are provided with a range of approaches to planning processes that may be better suited or supportive of the *intended* learning experience. Furthermore, this research study has found that certain teaching strategies, such as questioning techniques and demonstrations would benefit from a greater focus during the planning stages.

- ***The concept of a learning outcome***

This study has found that learning outcomes reinforce the tensions created by ‘evidencing learning’, and the current pedagogical frameworks, in their current form, are both misunderstood as concepts and misused within the teaching-learning process. Thus, the current use of learning outcomes is both impractical and unrealistic in terms of supporting *classroom-based learning*. As this research study suggests, in order for learning outcomes to be useful for teachers, and meaningful within the teaching-learning process, they need to be viewed as flexible and responsive rather than pre-determined and rigid. Learning outcomes, as with *ILS*, need to be seen as guiding the learning journey, providing the teacher with a *suggestion* or *indication* of what might be the possible outcome. As Hussey and Smith (2003: 357) argue, learning outcomes ‘need to be “reclaimed from their current use as devices for monitoring and auditing” and returned to the *intended* use by teachers to understand their students’. As such, learning outcomes need to be responsive to the type of learning and the discipline requirements.

The need for a greater emphasis on developing teachers' thinking about the proper use of learning outcomes in aiding good teaching and learning is prevalent within the relevant literature (Daugherty et al., 2008; James, D., 2005; Hussey and Smith, 2003; 2008). Teachers need to either adapt the concept of a learning outcome in order to support *classroom-based learning* or reject it. Learning outcomes need to be operationalised and their role in the teaching-learning process needs to be clearly defined and justified. Furthermore, methods of capturing learning and gathering learning outcomes need to be discussed and a range of possible methods identified.

In order to develop the skills, knowledge and understanding associated with Design and Technology 'teacher-dominated' outcomes of learning cannot be the standard approach (Nicholl and McLellan, 2009). Although beneficial in relation to skills acquisition and providing evidence of learning progress, 'teacher-dominated' learning outcomes tend to neglect *deep* learning experiences, whilst promoting replication of knowledge and skills through a procedural approach. Progression through Key Stage 3 needs to provide a variety of teaching-learning opportunities, ranging from 'teacher-controlled' units to 'mix authority' teaching to 'student-led' activities. In response to the design brief or problem, the degree of freedom given to the students is inversely proportional to the control of the variables, such as materials and time, by the teacher. 'Student-led' or 'student-managed' activities need to be based upon authentic tasks, collaboration and the processes involved in designing and making. Both the *iterative* and *user-centred* design approaches, if employed effectively, produce solutions that are neither predetermined nor foreseen. Both models require design development to be based upon 'authentic' feedback, either from prototyping and modelling or from user testing; consequently, both approaches can be described as 'designer-led' or, indeed, 'student-led' activities. Student ownership of learning outcomes would help address the narrow band of learning outcomes that currently exist in classrooms, improve creativity, reduce issues with validity and learning outcomes and provide authentic responses to *ILS*.

- ***The international context***

Irrespective of whether the system of education is outcomes-based or influenced by an OBE policy, planning is a process that could be explored by all *Technology* teachers. Teachers of *Technology* need to consider the implications of their current approaches to planning on the teaching and learning of their subject. As with Initial Teacher Education contexts, (see p. 272 below) planning for teaching and learning provides an effective framework to discuss, develop and address the requirements of the subject in a strategic, focused way.

8.2 Reflections on the study

This research study involved a complex data-gathering phase consisting of three distinct, yet inter-connected studies. Whilst the pilot study resulted in several adaptations to the overall design of the research study, there were aspects that could be developed even further to provide 'fuller and richer' data for analysis (Anyon, 2009: 6). These aspects of the research study are discussed below.

- ***Validation checks***

The inclusion of two validation checks was crucial in ensuring the findings were both recognisable and relevant to teachers. Validation check 1 allowed the KLTs the opportunity to reinforce the main points from Study 1, whilst validation check 2 provided an opportunity to clarify the key findings from a teaching perspective. In this regard, both validation checks were critical. During the pre data collection stage, ensuring an effective mechanism to allow the data produced by the three studies to be analysed in such a way as to ensure the relationship between the three studies was emphasised, was considered key. However, in hindsight, as it provided the foundations for

Studies 2 and 3, the data retrieved and analysed in Study 1 required a clearer focus. Whilst Study 1 involved a thematic analysis of 47 Design and Technology lesson plans and a survey, it could have been supplemented by teacher interviews regarding the mechanisms and key considerations involved in planning learning opportunities. This would have allowed the researcher to 'dig deeper' into the processes and procedures involved (Roulston, de Marrais and Lewis, 2003) and thus provide a stronger foundation for the subsequent two studies.

- ***The Learning Journey Concept Map***

The design and use of the pre and post *LJCM* was a significant breakthrough in relation to how the results were analysed in Study 2 and proved advantageous in several ways. Firstly, it provided a means of clearly 'seeing' the learning journey and how it related to the *ILS*. Secondly, it allowed a direct comparison between post and pre *LJCM*, and thus between *intended* and *actual* learning. Thirdly, it provided a means of identifying the formative assessment strategies and their location within the learning journey and then comparing the *intended* and *actual* formative assessment opportunities. Finally, it allowed the learning progress to be plotted episode by episode, thus indicating the method of planning used by the teachers.

Whilst the benefits to this research study of the *LJCM* model are clear, it would have been useful to show the pre and post *LJCM* to the teachers who planned and taught the lesson. This would have allowed a greater insight into the rationale behind some of their planning decisions and could have formed the basis of the second validation check.

It was encouraging that two of the seven participating schools planned to develop the idea of a *LJCM.* School A was intending to use it with their Newly Qualified Teachers (NQTs) to support planning for progression, whilst School C intended to modify the concept to be used directly in the classroom as a formative assessment support for the students. The short-term plan was to use learning journey concept mapping with their less-able students to help identify and provide a clear representation of their learning progress, which was hoped would help build self-confidence and develop a greater motivation for learning. If successful the idea could be developed further. The *LJCM* has potential to be used in a range of teaching-learning areas, for example, planning, assessment and Continual Professional Development (CPD).

- ***Initial Teacher Education (ITE)***

Design and Technology teacher training typically takes place through school-led training, that is, practical, hands-on teacher training ideally delivered by experienced, practising teachers based in their own school. As such, the process of planning and the design of planning pro formas are often influenced, if not directly attributable to training teachers' school-based experiences. The process of planning is often reduced to a performance indicator or merely one of a number of teaching competences required for qualification as a teacher (Mutton, Hagger and Burn, 2011), where ITE partnerships enable trainees to meet the minimum level of practice expected of teachers by the end of the training (Ofsted, 2015). As such the planning process is often degraded.

As this research study has demonstrated, the planning process is an integral part of the teaching-learning process and one that needs further exploration in relation to current teaching-learning processes. ITE is the ideal place to consider planning. Through a process of creation and collaborative planning, 'novice' teachers and their mentors could explore and identify what may or may not be effective within a subject specific context. Furthermore lesson planning pro formas can be used as learning aids for discussing Design and Technology learning and teaching.

8.3 Recommendations for further developments

Due to the complexity of this research study, several issues can be recommended for further development.

- ***The formal and informal planning processes***

Planning is a crucial aspect of the teaching-learning process, yet *informal* planning processes tend to be cognitive and personal and, therefore, overlooked or disregarded, seemingly as the focus has been on the more *formal* planning procedures. This situation needs to be addressed in order to explore and develop this stage in the teaching-learning process. The *informal* and *formal* planning processes highlighted in this research study would benefit from being investigated further to accommodate the specific nature of a discipline (Kagan and Tippins, 1992). Indeed, subject specific planning templates that support the teaching-learning process could ensure consideration of the pedagogical aspects of Design and Technology, whilst satisfying any auditing and monitoring requirements.

The apparent need for creativity in the planning process, demonstrated in the research study findings, appears to be contrary to the negative regard for planning held by many teachers. Given this, it would be interesting to investigate Design and Technology teachers' perceived 'creative need' during the planning process, particularly in regard to the creative nature of Design and Technology, the type of teachers who teach the discipline, or a possible reaction to the 'dominant' and less creative *formal* planning process.

- ***Methods of capturing and gathering learning***

The concept of a secondary learning outcome, produced as a result of the method identified to gather and/or capture the learning, is an area that warrants further consideration and, possibly, development. Unfortunately, suitable methods to capture and gather learning outcomes were not considered by the teachers in this research study; therefore, it was not possible to look at the transformation process from learning, to learning outcome, to secondary learning outcome (Sadler, 1989). Secondary artefacts are produced through a process of transformation into another form, clearly influencing the relationship between *intended* and *actual* learning, and raising issues around authenticity, validity and reliability and demonstrated learning.

- ***Learning outcomes and learners***

It was disappointing to observe the students' responses to the *ELOs* in Study 3. The current tension between Government policies and teachers' practices clearly has an impact on students' learning and their understanding of their learning processes (Hagger and Hodkinson, 2009), and students' confusion in response to both identifying and formulating learning was apparent. Given this, it would be a useful development to repeat Studies 2 and 3 with a focus on students and, in particular, how learning can be demonstrated and the interpretation of learning outcomes. By asking students to discuss their own learning outcomes in terms of demonstrating learning, direct comparisons could be made to the learning inferred by the teachers in response to the *ELOs*.

- ***The concept of an ELO***

This research study found that the process of identifying, evidencing and potentially reporting learning progress on particular aspects of learning could be developed through the concept of *ELOs.* By collecting *ELOs* throughout the lesson, the learning journey could be plotted, providing the teacher and the student opportunities to review the learning and identify any potential issues early on. The concept of an *LJCM* (pre and post) could be developed to support the processes further and investigated in relation to the current use of learning outcomes.

8.4 Conclusion

The 'design process' model used by Design and Technology teachers supports the current approach to secondary education, providing the required learning outcomes and satisfying a focus upon learning progress, measurement of learning and evidence of learning. Whilst such a linear, sequential, 'out-put' approach is replicated by the design process, this research study argues that, as a consequence, the type and depth of learning suffers. Indeed, the potential of the subject, in terms of student enjoyment, teacher satisfaction, challenge and creativity suffers, creating a tension between what is realistically and practically achieved within such an OBE system and what could be achieved. The 2014 National Curriculum potentially provides opportunities for teachers to develop new and innovative ways of teaching and, therefore, planning. However, unless teachers take ownership of curriculum and pedagogy developments, for example through developing the use of learning outcomes, the teaching and learning of Design and Technology could become ‘straight-jacketed’. The Design and Technology community, both national and international, needs to re-evaluate Design and Technology pedagogy, embrace the challenge and confidently create change.

Glossary of terms

Term	**Definition**
Assessment	The evaluation or estimation of the nature, quality, or ability of someone or something.
Formative assessment	‘The process of seeking and interpreting evidence for us by learners and their teachers to decide where the learners are in their learning, where they need to go and how best to get there’ (Assessment Reform Group, 2002).
Summative assessment	Summative assessment focuses on determining what the student has learned at the end of a unit of work or at the end of a Key Stage. Summative assessment helps determine to what extent the learning intentions have been met.
Intended Learning Statement *(ILS)*	A statements that describe what the teacher *intends* the learner to learn.
Learning outcome	What students produce at the end of a lesson or sequence of lessons that will demonstrate the learning that has taken place. Considered the same as evidence of learning
ELO	*ELO(s)* refers to the set of learning outcomes produced at the end of several episode that make up a lesson or learning journey.
Learning opportunities	The teacher designed activities during a lesson that allow the student to learn.
Learning journey	Either a phase in the lesson or the entire lesson that has been designed as a ‘journey’ that is, from a given starting point, through to an intended finishing line. The learning journey will demonstrate the learning progress
Success criteria	Criteria used by both the teacher and learner to assess the *ELO* or learning outcomes against.

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Table of Appendices

APPENDIX A: The 2007 Design and Technology Importance Statement

The importance of design and technology

In design and technology pupils combine practical and technological skills with creative thinking to design and make products and systems that meet human needs. They learn to use current technologies and consider the impact of future technological developments. They learn to think creatively and intervene to improve the quality of life, solving problems as individuals and members of a team.

Working in stimulating contexts that provide a range of opportunities and draw on the local ethos, community and wider world, pupils identify needs and opportunities. They respond with ideas, products and systems, challenging expectations where appropriate. They combine practical and intellectual skills with an understanding of aesthetic, technical, cultural, health, social, emotional, economic, industrial and environmental issues. As they do so, they evaluate present and past design and technology, and its uses and effects. Through design and technology pupils develop confidence in using practical skills and become discriminating users of products. They apply their creative thinking and learn to innovate.

APPENDIX B: Design and Technology attainment target level descriptions

Level 1

Pupils generate ideas and recognise characteristics of familiar products. Their plans show that, with help, they can put their ideas into practice. They use pictures and words to describe what they want to do. They explain what they are making and which tools they are using. They use tools and materials with help, where needed. They talk about their own and other people's works in simple terms and describe how a product works.

Level 2

Pupils generate ideas and plan what to do next, based on their experience of working with materials and components. They use models, pictures and words to describe their designs. They select appropriate tools, techniques and materials, explaining their choices. They use tools and assemble, join and combine materials and components in a variety of ways. They recognise what they have done well as their work progresses, and suggest things they could do better in the future.

Level 3

Pupils generate ideas and recognise that their designs have to meet a range of different needs. They make realistic plans for achieving their aims. They clarify ideas when asked and use words, labelled sketches and models to communicate the details of their designs. They think ahead about the order of their work, choosing appropriate tools, equipment, materials, components and techniques. They use tools and equipment with some accuracy to cut and shape materials and to put together components. They identify where evaluation of the design and make process and their products has led to improvements.

Level 4

Pupils generate ideas by collecting and using information. They take users' views into account and produce step-by-step plans. They communicate alternative ideas using words, labelled sketches and models, showing that they are aware of constraints. They work with a variety of materials and components with some accuracy, paying attention to quality of finish and to function. They select and work with a range of tools and equipment. They reflect on their designs as they develop, bearing in mind the way the product will be used. They identify what is working well and what could be improved.

Level 5

Pupils draw on and use various sources of information. They clarify their ideas through discussion, drawing and modelling. They use their understanding of the characteristics of familiar products when developing and communicating their own ideas. They work from their own detailed plans, modifying them where appropriate. They work with a range of tools, materials, equipment, components and processes with some precision. They check their work as it develops and modify their approach in the light of progress. They test and evaluate their products, showing that they understand the situations in which their designs will have to function and are aware of resources as a constraint. They evaluate their products and their use of information sources.

Level 6

Pupils draw on and use a range of sources of information, and show that they understand the form and function of familiar products. They make models and drawings to explore and test their design thinking, discussing their ideas with users. They produce plans that outline alternative methods of progressing and develop detailed criteria for their designs and use these to explore design proposals. They work with a range of tools, materials, equipment, components and processes and show that they understand their characteristics. They check their work as it develops and modify their approach in the light of progress. They evaluate how effectively they have used information sources, using the results of their research to inform their judgements when designing and making. They evaluate their products as they are being used, and identify ways of improving them.

Level 7

Pupils use a wide range of appropriate sources of information to develop ideas. They investigate form, function and production processes before communicating ideas, using a variety of media. They recognise the different needs of a range of users and develop fully realistic designs. They produce plans that predict the time needed to carry out the main stages of making products. They work with a range of tools, materials, equipment, components and processes, taking full account of their characteristics. They adapt their methods of manufacture to changing circumstances, providing a sound explanation for any change from the design proposal. They select appropriate techniques to evaluate how their products would perform when used and modify their products in the light of the evaluation to improve their performance.

Level 8

Pupils use a range of strategies to develop appropriate ideas, responding to information they have identified. When planning, they make decisions on materials and techniques based on their understanding of the physical properties and working characteristics of materials. They identify conflicting demands on their design, explain how their ideas address these demands and use this analysis to produce proposals. They organise their work so that they can carry out processes accurately and consistently, and use tools, equipment, materials and components with precision. They identify a broad range of criteria for evaluating their products, clearly relating their findings to the purpose for which the products were designed and the appropriate use of resources.

Exceptional performance

Pupils seek out information to help their design thinking, and recognise the needs of a variety of client groups. They are discriminating in their selection and use of information sources to support their work. They work from formal plans that make the best use of time and resources. They work with tools, equipment, materials and components to a high degree of precision. They make products that are reliable and robust and that fully meet the quality requirements given in the design proposal.

1 Key concepts

There are a number of key concepts that underpin the study of design and technology. Pupils need to understand these concepts in order to deepen and broaden their knowledge, skills and understanding.

1.1 Designing and making

a Understanding that designing and making has aesthetic, environmental, technical, economic, ethical and social dimensions and impacts on the world.
b Applying knowledge of materials and production processes to design products and produce practical solutions that are relevant and fit for purpose.
c Understanding that products and systems have an impact on quality of life.
d Exploring how products have been designed and made in the past, how they are currently designed and made, and how they may develop in the future.

1.2 Cultural understanding

a Understanding how products evolve according to users' and designers' needs, beliefs, ethics and values and how they are influenced by local customs and traditions and available materials.
b Exploring how products contribute to lifestyle and consumer choices.

1.3 **Creativity**

a Making links between principles of good design, existing solutions and technological knowledge to develop innovative products and processes.
b Reinterpreting and applying learning in new design contexts and communicating ideas in new or unexpected ways.
c Exploring and experimenting with ideas, materials, technologies and techniques.

1.4 **Critical evaluation**

a Analysing existing products and solutions to inform designing and making.
b Evaluating the needs of users and the context in which products are used to inform designing and making.
c Exploring the impact of ideas, design decisions and technological advances and how these provide opportunities for new design solutions.

Key processes

These are the essential skills and processes in design and technology that pupils need to learn to make progress.

Pupils should be able to:

- a generate, develop, model and communicate ideas in a range of ways, using appropriate strategies
- b respond creatively to briefs, developing their own proposals and producing specifications for products
- c apply their knowledge and understanding of a range of materials, ingredients and technologies to design and make their products
- d use their understanding of others' designing to inform their own
- e plan and organise activities and then shape, form, mix, assemble and finish materials, components or ingredients
- f evaluate which hand and machine tools, equipment and computer-aided design/manufacture (CAD/CAM) facilities are the most appropriate to use
- g solve technical problems
- h reflect critically when evaluating and modifying their ideas and proposals to improve products throughout their development and manufacture.

APPENDIX E: Sample lesson plan pro formas

Context of Lesson

Subject:	Level Course/Type:	Unit:	Lesson
Lesson Title (from MTP):			
Progress Question (from MTP):			

Organisation of Lesson

Differentiated Learning Objectives	**Differentiated Learning Outcomes**

6Rs

CONNECT:	**Differentiation**
Key Questions?	

ACTIVATE:	**Differentiation**
Key Questions?	

DEMONSTRATE:	**Differentiation**
Key Questions?	

CONSOLIDATE:	**Differentiation**
Key Questions?	
Homework	

AFL Strategies:

Exemplar Material	Modelling	Peer Assessment	Self Assessment	Varied Questioning

Summative Assessment Criteria e.g. Classroom Monitor Statements/Syllabus assessment criteria

LEARNING PLAN

Teacher:	**Class:**	**Date:** 16.10.2008	**B**		**G**	
Subject:	**Current Levels:**	**Lesson:**	**G & T**		**SEN**	

Learning Objectives / Outcomes: (What will students know, understand and be able to do)
1.

All –
Most –
A few –

EXTENSION:

Time	**T & L Activities / Episodes:** (Which will lead to learning outcomes e.g. starter and core episodes)	**Differentiation:** (How starter and core episodes meet needs of different learners) -
	Plenary Assessment: (Evidence of pupil learning)	

Homework: (To extend / reinforce learning outcomes)	**Resources:** (If applicable)
Evaluation of student learning:	**Issues arising to consider for next lesson:**
Cross Curricular Links: (Lit, Num, ICT, Citizenship) Literacy: Key words, terminology.	**Risk Assessment:**

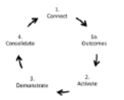
CHECKLIST: ASSESSMENT FOR LEARNING		**PAIR / GROUP WORK**		**VAK**	

LEARNING PLAN

Context of Lesson:			
Learning Objective	**What progress will the different groups make?**		
	G&T	**SEND**	
Starter-Connect Learning/Introduce new learning:			
Learning Activities **Teacher Input/Making Sense/Review**	**Formative Assessment Strategies – Including Success Criteria** Success Criteria •		

Making Sense Strategies – We can increase the chances of pupils understanding (*the penny dropping moment*) by using the following strategies: Verbalising Reduction Transformation Teaching Something Sequencing Offering analogies 'It's like…' Predicting Classifying Problem solving/investigations/enquiry Creating learning maps Rank ordering Higher-Order questioning Thinking about thinking Understanding the question Learners asking questions More information on these strategies is available from Chris or Annette

Rugeley Academies - Learning Plan



Teacher MR / MRS / MS/ MISS	**Class 7**	**Date**
Module Title	**Lesson Title**	**Driving Question**

1.Connect (Stimulate students' curiosity by directing them to the topic)			
Learning Activities	Differentiation	Progress Review (P15)	Teaching Strategies 3, 5
1a.Learning Outcomes			
All: Most: Some:			Teaching Strategies
2.Activate (Introduce the key learning / issue / problem)			
Learning Activities Discuss through Q's and A's colour theory primary and secondary colours, Explain colour theory task – and show colour in motion videos.	Differentiation	Progress Review (P15)	Teaching Strategies
3.Demonstrate (Students show what they have learned)			
Learning Activities	Differentiation	Progress Review (P15)	Teaching Strategies
4.Consolidate (Students examine what has been learned / preview what is coming next)			
Learning Activities explicitly linked to learning outcomes		Progress Review (P15)	Teaching Strategies
Homework Create a pattern from found objects and materials.			

The Rugeley 10 Teaching Strategies
1. Active Engagement
2. Clarity of Purpose
3. Quality Questioning
4. Differentiated Challenge
5. Problem Solving
6. Independent and Co-operative Learning
7. Demonstrating Progress
8. Reviewing and Evaluating
9. Creative Learning
10. Making links and Connections

Key Information for Differentiation

Statemented		Most Able at Level/Grade	
SEN		Average Level/Grade	
G&T		Least Able Level/Grade	
LAC		Reading Age highest	
FSM		Reading Age lowest	

Literacy

-

CRUCIAL SKILLS: Numeracy [ ] Communication [ ] Independent Learning [ ] Problem Solving [ ] SMSC [ ]

Learning Plan

[redacted]

Teacher:	**Class:**	**Date: 27.02.2012**	**B**		**G**	
Subject:	**Current Levels:**	**Lesson:**	**G & T**		**SEN**	

Learning Objective:

Learning Outcomes: (What will students know, understand and be able to do)
All –
Most –
A few –

Time	**T & L Activities / Episodes:** (Which will lead to learning outcomes e.g. starter and core episodes) **Starter activity:** **Who? What? Where? Why? When? How?:** **Task 1** – **Task 2** – *(Evidence checklist: differentiation, use of TA, SEN, AFL, pair/group work, VAK, etc)*

x

APPENDIX F: Teacher consent forms for Studies 2 and 3

“The research for this project was submitted for ethics consideration under the reference EDU 12/046 in the Department of Education and was approved under the procedures of the University of Roehampton’s Ethics Committee on 1 June 2012”.

University of Roehampton London

ETHICS COMMITTEE
TEACHER CONSENT FORM (STUDY 2)

Overall purpose of the research:
This study aims to investigate pupils' learning and pedagogy in D&T lower secondary classroom, focussing on the planning, teaching and assessment procedures used, and asking if they are valid and effective. It will lead to a better understanding of current practices of assessment in D&T and extend understanding of how these could be modified. It will include recommendations and suggestions of approaches and strategies that could be used to improve current practices.

Title of Research Project: An investigation of the relationships between the learning intention and the learning outcome(s) in lower secondary Design and Technology classrooms.

Brief Description of Research Project:
This research will involve 10 lesson observations, 7 in Design and Technology lessons and 3 in Science lessons. The corresponding lesson plan will be analysed in advance and the observations will focus solely upon identifying and observing the intended learning outcome(s). The observations will take place in the *normal* learning environment. Written notes will be taken during the observation. It will be necessary to 'capture' the learning outcome at the end of each lesson, ideally in electronic format. Both teachers and students will be anonymised.

Investigator Contact Details:

Mary Southall
South View
Cheadle Road
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Staffs
ST10 3AN
07771 906 584
southalm@roehampton.ac.uk

Consent Statement:

I agree to take part in this research, and am aware that I am free to withdraw at any point. I understand that the information I provide will be treated in confidence by the investigator and that my identity will be protected in the publication of any findings.

Name …………………………………

Signature ……………………………………………………………………………………

Date ……………………………………

Please note: if you have a concern about any aspect of your participation or any other queries please raise this with the investigator. However, if you would like to contact an independent party please contact the Head of Department (or if the researcher is a student you can also contact the Director of Studies

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M.Holness@roehampton.ac.uk

ETHICS COMMITTEE
TEACHER CONSENT FORM STUDY THREE

Overall purpose of the research:
This study aims to investigate pupils' learning and pedagogy in D&T lower secondary classroom, focussing on the planning, teaching and assessment procedures used, and asking if they are valid and effective. It will lead to a better understanding of current practices of assessment in D&T and extend understanding of how these could be modified. It will include recommendations and suggestions of approaches and strategies that could be used to improve current practices.

Title of Research Project: An investigation of the relationships between the learning intention and the learning outcome(s) in lower secondary Design and Technology classrooms.

Brief Description of Research Project:
This research involves participation in a focus group. The group will involve between 3–7 Design and Technology or Science teachers identifying learning intentions through discussing learning outcomes. Ten learning outcomes will be discussed. The focus group will take place in a quiet room and you will not be disturbed for the necessary duration. The researcher will explain the task in detail at the start and will make brief notes throughout. All names will be anonymised.
It is envisaged that the focus group will take a maximum of 1½ hours.

Your participation in the project is voluntary and all participants have the right to withdraw once the study has commenced.

Investigator Contact Details:

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southalm@roehampton.ac.uk
07771 906 584

Consent Statement:
I agree to take part in this research, and am aware that I am free to withdraw at any point. I understand that the information I provide will be treated in confidence by the investigator and that my identity will be protected in the publication of any findings.

Name …………………………………………

Signature ………………………………………

Date …………………………………

Please note: if you have a concern about any aspect of your participation or any other queries please raise this with the investigator. However, if you would like to contact an independent party please contact the Head of Department (or if the researcher is a student you can also contact the Director of Studies.)

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APPENDIX G: Student consent form Studies 2 and 3

University of Roehampton
London

ETHICS COMMITTEE
STUDENT CONSENT FORM STUDY TWO

Overall purpose of the research:
This study aims to investigate pupils' learning and pedagogy in D&T lower secondary classroom, focussing on the planning, teaching and assessment procedures used, and asking if they are valid and effective. It will lead to a better understanding of current practices of assessment in D&T and extend understanding of how these could be modified. It will include recommendations and suggestions of approaches and strategies that could be used to improve current practices.

Title of Research Project: An investigation of the relationships between the learning intention and the learning outcome(s) in lower secondary Design and Technology classrooms.

Brief Description of Research Project:
This research will involve a series of lesson observations, 7 in Design and Technology lessons and 3 in science lessons and will focus solely upon identifying and observing the intended learning outcome(s). The observations will take place in your normal learning environment with your regular teacher. The researcher will take written notes during the observation. Both teachers and students will be anonymised.

It will be necessary to 'capture' the learning outcome at the end of each lesson, ideally in electronic format. Any work that you contribute to the project will only be reviewed or used if you give us your permission. Everything you write or draw will be anonymised; we will not use your real name or anything else that might identify who you are and where you live. Your participation in the project is voluntary – no one can make you do this – so if you do not want to take part or decide that you do not want your pictures or writing used, you can tell us and we will make sure that they are removed from the data we collect and publish.

If you are happy about taking part, please write your name in the space below and sign this form. You should then take it back to school with you to give to your teacher.

Consent Statement:
I agree to take part in this research, and am aware that I am free to withdraw at any point. I understand that the information I provide will be treated in confidence by the investigator and that my identity will not be disclosed in the publication of any findings unless I give my written consent.

Name …………………………………

Date ……………………………………

Signature ………………………………………

Lead Investigators Contact Details:

Mary Southall
South View, Cheadle Road,
Oakamoor, Staffs ST10 3AN
07771906584
southalm@roehampton.ac.uk

Please note: if you have a concern about any aspect of your participation or any other queries please raise this with the investigator. However, if you would like to contact an independent party please contact the Head of Department (or if the researcher is a student you can also contact the Director of Studies.)

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University of Roehampton London

ETHICS COMMITTEE
STUDENT CONSENT FORM STUDY THREE

Overall purpose of the research:
This study aims to investigate pupils' learning and pedagogy in D&T lower secondary classroom, focussing on the planning, teaching and assessment procedures used, and asking if they are valid and effective. It will lead to a better understanding of current practices of assessment in D&T and extend understanding of how these could be modified. It will include recommendations and suggestions of approaches and strategies that could be used to improve current practices.

Title of Research Project:
An investigation of the relationships between the learning intention and the learning outcome(s) in lower secondary Design and Technology classrooms

Brief Description of Research Project:
Phase three of this study requires a focus group to discuss learning intentions and learning outcomes. The focus group will involve between 3-7 KS3 pupil discussing learning outcomes and trying to identify the learning intention. The focus groups will be informal and take place in a quiet room in school and you will not be disturbed. The aims of the group will be presented at the start to ensure you feel happy and confident about what you are being asked to do. The researcher will take brief notes on your discussions. It is envisaged that focus group will take no longer than 1 hour.

We will not use your real name or anything else that might identify who you are and where you live. Your participation in the project is voluntary – no one can make you do this – so if you do not want to take part once the study has commenced you can tell us and we will make sure that all data will be removed.

If you are happy about taking part, please write your name in the space below and sign this form. You should then take it back to school with you to give to your teacher.

Consent Statement:
I agree to take part in this research, and am aware that I am free to withdraw at any point. I understand that the information I provide will be treated in confidence by the investigator and that my identity will not be disclosed in the publication of any findings unless I give my written consent.

Name ………………………………….

Signature ………………………………………

Date ……………………………………………

Lead Investigators Contact Details:

Mary Southall
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Please note: if you have a concern about any aspect of your participation or any other queries please raise this with the investigator. However, if you would like to contact an independent party please contact the Head of Department (or if the researcher is a student you can also contact the Director of Studies.)

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APPENDIX H: Parental consent forms Studies 2 and 3

University of Roehampton
London

ETHICS COMMITTEE
PARENTAL CONSENT FORM (STUDY 2)

Overall purpose of the research:
This study aims to investigate pupils' learning and pedagogy in D&T lower secondary classroom, focussing on the planning, teaching and assessment procedures used, and asking if they are valid and effective. It will lead to a better understanding of current practices of assessment in D&T and extend understanding of how these could be modified. It will include recommendations and suggestions of approaches and strategies that could be used to improve current practices.

Title of Research Project: An investigation of the relationships between the learning intention and the learning outcome(s) in lower secondary Design and Technology classrooms.

Brief Description of Research Project:
This research will involve a lesson observation in your child's (insert subject) lesson. The corresponding lesson plan will be analysed in advance and the observations will focus solely upon identifying and observing the intended learning outcome(s). The observations will take place in the *normal* learning environment. Written notes will be taken during the observation. It will be necessary to 'capture' your child's learning outcome at the end of the lesson, ideally in electronic format. All teachers and students will be anonymised.

Investigator Contact Details:

Mary Southall
South View
Cheadle Road
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ST10 3AN
07771 906 584
southalm@roehampton.ac.uk

Consent Statement:
I agree for my child to take part in this research, and am aware that I they are free to withdraw at any point. I understand that the information they might provide will be treated in confidence by the investigator and that there identity will be protected in the publication of any findings.

Name of student ....

Parent/carer signature ....

Date ....

Please note: if you have a concern about any aspect of your participation or any other queries please raise this with the investigator. However, if you would like to contact an independent party please contact the Head of Department (or if the researcher is a student you can also contact the Director of Studies.)

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ETHICS COMMITTEE
PARENTAL CONSENT FORM STUDY THREE

Overall purpose of the research:
This study aims to investigate pupils' learning and pedagogy in D&T lower secondary classroom, focussing on the planning, teaching and assessment procedures used, and asking if they are valid and effective. It will lead to a better understanding of current practices of assessment in D&T and extend understanding of how these could be modified. It will include recommendations and suggestions of approaches and strategies that could be used to improve current practices.

Title of Research Project: An investigation of the relationships between the learning intention and the learning outcome(s) in lower secondary Design and Technology classrooms.

Brief Description of Research Project:
This research involves participation in a focus group. The group will involve between 3–7 KS3 students, identifying learning intentions through discussing learning outcomes. The focus group will take place in a quiet room and the students will not be disturbed for the necessary duration. The researcher will explain the task in detail at the start and will make brief notes throughout. All names will be anonymised.
It is envisaged that the focus group will take a maximum of ½ hours.
Your child's participation in the project is voluntary and all participants have the right to withdraw once the study has commenced.

Investigator Contact Details:

Mary Southall
South View
Cheadle Road
Oakamoor, Staffs.
ST10 3AN
07771 906 584
southalm@roehampton.ac.uk

Consent Statement:
I agree to take part in this research, and am aware that they are free to withdraw at any point. I understand that the information they provide will be treated in confidence by the investigator and that their identity will be protected in the publication of any findings.

Name of student

……………………………………

Parent/carer signature

………………………………………

Date …………………………

Please note: if you have a concern about any aspect of your child's participation or any other queries please raise this with the investigator. However, if you would like to contact an independent party please contact the Head of Department (or if the researcher is a student you can also contact the Director of Studie

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APPENDIX I: Head Teachers' introductory letter and consent form

University of Roehampton
London

Dear (Head Teacher)

I am writing to request your agreement for your Design and Technology and Science Departments to take part in research I am undertaking for my PhD at the University of Roehampton. I have informally contacted (name of key link teacher) and provided an outline of the project, including aims and requirements and they have indicated that, with your permission, they are pleased to be involved.

Overall purpose of the research:
This study aims to investigate pupils' learning and pedagogy in D&T lower secondary classroom, focussing on the planning, teaching and assessment procedures used, and asking if they are valid and effective. It will lead to a better understanding of current practices of assessment in D&T and extend understanding of how these could be modified. It will include recommendations and suggestions of approaches and strategies that could be used to improve current practices.

Title of Research Project: An investigation of the relationships between the learning intention and the learning outcome(s) in lower secondary Design and Technology classrooms.

Brief Description of Research Project:
The research has two stages, the first stage comprises analysis of 50 lesson plans (from a range of schools in Staffordshire and Derbyshire). The lesson plans will involve both design and technology (D&T) (40 plans) and science (10 plans) departments. (Name of key link teacher) will be asked to provide at least 10 lesson plans. The aim of this stage is to provide some insights into the processes and procedures teachers use to plan the intended learning.

The second stage will involve a series of lesson observations, 7 in D&T lessons and 3 in science lessons and will focus solely upon identifying and observing the intended learning outcome(s). The observations will take place in normal learning environments with the regular teacher. The researcher will take written notes during the observation. Both teachers and students will asked for their agreement, be free to withdraw at any point and be anonymous. It will be necessary to 'capture' the learning outcome(s) at the end of each lesson, ideally in electronic format. Any data that is collected will be stored securely, reviewed and only used to contribute to my PhD findings if relevant permission has been granted.

If you have any queries please do contact me. I would appreciate it if you would confirm your agreement for your school to take part in this research by email and I look forward to hearing from you.

Yours sincerely.

Mary Southall

Mary Southall

Lead Investigators Contact Details:

Mary Southall
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Oakamoor, Staffs. ST10 3AN
Southalm@roehampton.ac.uk
0777190658

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M.Holness@roehampton.ac.uk

University of Roehampton
London

Dear ,

I am writing to request your written consent for [   ] to take part in Study 2 of my research, namely the observation stage.

Overall purpose of the research:
This study aims to investigate pupils' learning and pedagogy in D&T lower secondary classroom, focussing on the planning, teaching and assessment procedures used, and asking if they are valid and effective. It will lead to a better understanding of current practices of assessment in D&T and extend understanding of how these could be modified. It will include recommendations and suggestions of approaches and strategies that could be used to improve current practices.

Title of Research Project: An investigation of the relationships between the learning intention and the learning outcome(s) in lower secondary Design and Technology classrooms.

Brief Description of Study 2 of the Research Project:
The second stage will involve a series of lesson observations, 7 in D&T lessons and 3 in science lessons and will focus solely upon identifying and observing the intended learning outcome(s). A maximum of two lesson observations will take place in each school involved in the research project. The observations will take place in normal learning environments with the regular teacher. The researcher will take written notes during the observation. Both teachers and students will asked for their agreement, be free to withdraw at any point and be anonymous.

It will be necessary to 'capture' the learning outcome(s) at the end of each lesson observation, ideally in electronic format. The learning outcome(s) 'captured' will be identified by the teacher and photographed. Any data that is collected will be stored securely, reviewed and only used to contribute to my PhD findings if relevant permission has been granted. If you have any queries please do contact me.

I would appreciate it if you would confirm your agreement below,

"I am aware that children will not be part of the observation process and no data will be collected on any individual child. As a consequence, I acknowledge that parental consent will not be required".

I agree to the school taking part in this study.

Head Teacher name ………………………………………….

Signature ………………………………………………………………

Date ……………………………………

Yours sincerely.

Mary Southall

Lead Investigators Contact Details:

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APPENDIX J: Briefing information for Study 3

University of Roehampton
London

ETHICS COMMITTEE

BRIEFING SHEET FOR FOCUS GROUP (Teachers and students)

Aims:
To ensure all participants understand their involvements in the task.

When:
At the start of each focus group.

Researcher to read out the following:

This study is aiming to investigate the relationships between the learning intention and the learning outcome(s) in Design and Technology KS3 classes.

This focus group aims to provide an objective view of the possible relationship.

Please find 10 examples of the evidence of learning outcomes. Work through the examples in number order, from 1 – 10.

In your group please discuss the intended learning associated with the learning outcome – e.g. the learning objective the teacher was working to in the lesson.

Once you have decided as a group please write down the proposed learning intention and reference it with the same number as the learning outcome.

I will be taking brief notes but no names or specific comments will be recorded.

Does anyone have any questions?

Thank you.

APPENDIX K: Ethics risk assessment Studies 2 and 3

Title:
An investigation of the relationships between the learning intention and the learning outcome(s) in lower secondary design and technology classrooms.

Risk Assessment No:	**Event / Activity:**	**Date Assessed:**	**Assessor's Name:**
1.1	lesson observation	**Review Date:**	**Assessor's Signature:**

		Uncontrolled Risk				**Residual Risk**			
		Severity x Likelihood = Risk Rating				**Severity x Likelihood = Risk Rating**			
Hazard	**To Whom**	**S**	**L**	**R**	**Control Risk by**	**S**	**L**	**R**	**Further Action Needed**
List the hazards involved in your project	*Who will be affected by the risk*				*List how you will control this hazard*	1		0	
Emotional distress	*The students*	1	1	1	*Students to be reassured before the lesson that although focus will be on them, it is just a 'normal' lesson and no judgements will be made on their learning*				
Emotional distress	*The teacher teaching the lesson*	1	1	1	*Teacher will be fully informed of the researchers aims during the lesson and the project as a whole. Participant can withdraw at any time*			0	
Emotional distress	The researcher	1	1	1	Only one observation per day	1		0	Support from superviser if necessary
Potential hazards in a D and T workshop e.g. machines	The researcher	1	1	1	Researcher to ask for a chair to be placed at the back of the room. The observation will take place from this location	1		0	

Severity		
HIGH	3	Fatality or major injury causing long-term disability
MEDIUM	2	Injury or illness causing short-term disability
LOW	1	Other injury or illness
Likelihood		
HIGH	3	Certain or near certain
MEDIUM	2	Reasonably likely
LOW	1	Very seldom or never

Risk Matrix

		Likelihood		
Severity		**H**	**M**	**L**
	H	9	6	3
	M	6	4	2
	L	3	2	1

Risk Rating

6 - 9 HIGH RISK	Immediate action required to reduce risk
3 - 4 MEDIUM RISK	Seek to further reduce risk
1 - 2 LOW RISK	No action but continue to monitor

Title:
An investigation of the relationships between the learning intention and the learning outcome(s) in lower secondary design and technology classrooms.

Risk Assessment No:	**Event / Activity:**	**Date Assessed:**	**Assessor's Name:**
1.2	Focus Group	**Review Date:**	**Assessor's Signature:**

		Uncontrolled Risk				**Residual Risk**			
		Severity x Likelihood = Risk Rating				**Severity x Likelihood = Risk Rating**			
Hazard	**To Whom**	**S**	**L**	**R**	**Control Risk by**	**S**	**L**	**R**	**Further Action Needed**
List the hazards involved in your project	*Who will be affected by the risk*				*List how you will control this hazard*	1		0	
Emotional distress	*The participants (both students and teachers groups)*	1	1	1	*Teachers aware of the aims of the focus group. Non participation is not noted. Withdrawal from the group is permitted at any time. Debriefing given at the end of the focus group.*	1	1	1	n/a

Severity		
HIGH	3	Fatality or major injury causing long-term disability
MEDIUM	2	Injury or illness causing short-term disability
LOW	1	Other injury or illness
Likelihood		
HIGH	3	Certain or near certain
MEDIUM	2	Reasonably likely
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Risk Matrix

		Likelihood		
Severity		**H**	**M**	**L**
	H	9	6	3
	M	6	4	2
	L	3	2	1

Risk Rating

6 - 9 HIGH RISK	Immediate action required to reduce risk
3 - 4 MEDIUM RISK	Seek to further reduce risk
1 - 2 LOW RISK	No action but continue to monitor

APPENDIX L: Predicted learning journeys related to each of the *ILS*

D&T 1

- To know what a template is
- To be able to create a template for their key ring
- To understand why a template is important when manufacturing

The lessons would be expected to involve some knowledge acquisition regarding what a template is, examples of templates used in the ‘real world’ and some criteria regarding what makes an effective template. The link to industry and the manufacturing in quantity would be needed.

D&T 2

- To understand how to use the marking criteria to measure the success of the completed point of sale display

‘To understand how to use’ would involve a method or procedural approach to ‘using’ followed by an opportunity to practice the approach.

D&T 3

- To be able to use the sewing machine safely and effectively

Students will need to know how to use the machine and have been taught the safety issues associated with it. They must have learnt to use the machine accurately.

D&T 4

- To understand what tonal shading is and how to press from plastic

The learning journey must include some explanation of what tonal shading is, why we use it and examples of how it can be used. ‘How to’ relates to learning the procedure for press forming.

D&T 5

- To review knowledge, understanding and progress

This *ILS* suggests the students already know how to review their knowledge and understanding and progress, as there is no learning related to 'how to review'. The *ILS* suggests a reflective approach.

D&T 6

- To be able to select the correct drawing equipment and produce basic third angle orthographic drawing to a 3mm tolerance

The learning journey will include an activity on selecting the appropriate drawing equipment, the steps needed to draw an orthographic projection and what tolerance is and how to apply it to the drawing.

D&T 7

- To have a clear understanding of how to construct their circuits
- To demonstrate good soldering (safely)
- To identify which activities they will need to carry out to make progress

The learning journey related to these *ILS* might include a demonstration on how to construct their circuits using good quality soldering. The lesson is focused upon independent learning and time management so will involve students managing their learning during the lesson time.

APPENDIX M: Pro forma Study 3

Learning outcome reference	**Agreed learning intention/objective relating to each set of learning outcomes (*ELOs*)**
A	
B	
C	
D	
E	
F	

APPENDIX N: Teachers' Focus Group responses

Learning Outcomes A:

- To understand how to use the marking criteria to measure the success of the completed PoS (L6)
- To understand how to use the marking criteria to measure the success of the completed PoS and generate detailed suggestions for further improvement (level 7)

Teachers Groups responses

To investigate PoS
NR
Evaluation of practical
Understand what a PoS is
Using assessment criteria to peer assess work
Students to read the NC assessment criteria then make judgements on what could be a level.
Accessing the language of level descriptors
Pupils will be able to put in rank order and level work, to understand the impact of graphic communication in PoS
To enable students to assess their own and others work using a set of success criteria
To understand target market, advertising, structure, in terms of assessment, possibly by peers
Peer assessment/testing/analysis Evaluation of other work
Point of Sale advertising - product name related
To develop knowledge of 3D merchandising techniques

Learning Outcomes B:

- To review knowledge, understanding and progress

Teachers Groups responses

To be able to reflect and identify areas of improvement?
NR
assessment (self) reflective / evaluation
Understand how to self assess
NR
Working out progression in food tech./Planning next steps
To identify SWOT and identify next steps/To structure a self assessment
NR
Evidencing assessment of learning and understanding
Evidence of progression (self review)
Pupils to evaluate next steps for progression
Develop knowledge and understanding of self-assessment and highlight strengths and areas for improvement

Learning Outcomes C:

- To be able to use the sewing machine safely and accurately

Teachers Groups responses

Use of sewing machine safely
To show that you can use the sewing machine
Applying manufacturing skills
Have the ability to move forward/improve/ understand how to use a sewing machine
To show knowledge, skills of using a sewing machine
How to use the sewing machine safely
To identify sewing machine parts and control basic use

To be able to use a sewing machine with a degree of accuracy
Know and understand how to use the sewing machine
Able to use sewing machine safely and correctly
Use sewing machine
NR

Learning Outcomes D:
To be able to select the correct drawing equipment
To produce basic 3rd angle orthographic drawings to a tolerance
Teachers Groups responses
To understand orthographic projection
To develop knowledge and skills in orthographic projections?
Communication (technical)/ Learning the conventions of orthographic skills assessment, ability to own)
To understand how to use working drawings/orthographic projections
Knowledge of graphic vocabulary and ability to draw a 3D object in orthographic projection
Understanding angles of projection
To understand process of orthographic projection and apply to given shapes and do a lovely work search!
To be able to demonstrate an understanding of orthographic drawing and identify skills needed
Be able to understand and apply orthographic projection
Translate/apply orthographic to 3D sketch
NR
NR

Learning Outcomes E:
- To have a clear understanding of how to construct their circuits
- To demonstrate good soldering (safely)
- Identify which activities they will need to carry out to make progress (3 or 4)

Teachers Groups responses
How to kill off electronics totally!!
To demonstrate?
To be able to produce a simple circuit/ control in context
NR
To construct a soldered circuit / ability to self review my work
How to solder safely a circuit and?
NR
Understand how to safely construct a electronic circuit
How to construct a circuit and case
Solder safely and how to construct circuit correctly
NR
NR

Learning Outcomes F:
- To understand what tonal shading is
- How to press from plastic (explain and safety precautions)

Teachers Groups responses
To trial/show vacuum forming
Understanding heat processes in plastics (press forming) Understanding a sequence of activities linked to oven forming / Using graphic techniques
NR
Be able to render 3D shapes/ To understand and practice press moulding/to know and understand the steps of press moulding in a story board

How to vac form
Understand the process of press forming and be label to complete cartoon strip with shading
NR
Understand the press forming process
Understand and practice press forming (shading?)
NR
To understand how tone can enhance 3D drawing

Learning Outcomes G:

- To be able to create a template for their key fob
- To understand why a template is important when manufacturing

Teachers Groups responses

To be able to use templates to produce a final outcome
To understand and demonstrate how and why we use templates
Using templates to produce batch production/ to develop a simple shape into a template
Develop a template in order to batch produce products/understanding material properties
Design a letter template to use to cut out of acrylic
Understanding the use of a template - QC
To create an economical template for a stylized font for use on acrylic
To understand why we need a template to use when cutting acrylic
To be able to understand what a template is/ To understand properties of acrylic
How to cut accurately using a jig and batch production
NR
How to model/prototype to ensure accuracy

APPENDIX O: Students' Focus Group responses

Learning outcome reference	Agreed learning intention/objective relating to each learning outcome	Field notes whilst students discuss possible ILS
A	All – be able to create a simple pop up model Most – be more creative when making the shape Some – make it unique and to a higher quality	The students focused on the making and the design and the quality of the design
B	All – to evaluate the basic details Most – to evaluate within depth information and detail Some – to evaluate with better vocab and more detail	General discussion about possible learning – no clear identification of the learning
C	All – to identify simple textiles vocab Most – to be able to label a sewing machine and understand how it works Some – to do all above and to learn how to use sewing machine successfully	Discussion was difficult and limited One student mentioned 'this would be better as a starter'
D	All – to identify graphic vocab Most – to know how to do simple graphic drawing for different angles, e.g. birds eye view Some – to be able to do independently and evaluate your strengths and weakness	D1 – related to all D2 – related to most D3 – related to some
E	All – to be able to create a basic circuit Most – to be able to do a self review Some – to be able to peer assess were you think you are at the end of the lesson	
F	All – to understand how to render Most – to understand how a vacuum former machine works Some – to do detailed diagrams of vacuum forming	
G	All – to know what a template is Most – use a basic template to create a more intricate design Some – to review what you have done and apply to future projects	

13 June 2013
4 Year 9 students (one boy, three girls)
General comments:

Students tended to focus upon the words to differentiate as opposed to the learning

Followed the format they used at the school they were in

Very focused upon literacy

Generally felt that providing an *ILS* was helped their learning as it gave focus to the lesson. Students were very unclear how to identify the learning throughout the focus group.

APPENDIX P: Teachers' responses to Study 1, part 2

A	The implementation of the 'whole lesson plan proforma' was a very difficult process, the entire department thought the same. As a result there is no ownership of the planning. No one understands the differentiated learning objectives, and the differentiated learning outcomes – it is completely mad! The planning has just become another task I need to do, that I don't really understand why or what for!
B	I have modified the school lesson plan proforma to suit my needs and the subject needs. I find the proforma very useful and I tend to use it as the first step in my planning – I plan straight onto the proforma. It makes sure I include everything I need to and that I don't miss any aspect of teaching and learning out
C	I think about the lesson in my head and tend to write notes on a piece of paper (could be scrap) and then go to the PowerPoint to help me formulise it into a complete lesson. The slides make me think about it in a 'step-by-step' way. I do use the lesson plan proforma but only when I am being observed. It does not help me plan as such but does help as it ensures everything is ok with the lesson. I could make alterations when I use the proforma and think about the lesson in a different way. For me it is like a quality check.
D	The lesson plan is already written, it is the same for all the five school in the [****]. It comes with the resources and everything. I don't really think about planning at all, but just read through the lesson plan and make sure there is not anything I can't delivery. I jot notes down in my planner, sometimes after, sometimes before the lesson. I do not like the lesson plan proforma – I don't understand it. I normally start with what I have to do – or what the students have to do e.g. construct their circuits and build the lesson around that. I start with a PowerPoint – I start messing around with slides. I have a vague idea of the learning but it firms up whilst I am designing the slides
E	I start with the aim of the lesson, i.e. what I need them to have learnt by the end of it. Then I think about how I can get there. This all goes on in my head, it is **me** thinking about those two questions. I then go to the learning objective planning format slide in PowerPoint or Word. I then start thinking about the levels. Finally I try and find some activities to meet them. I generally either ask a colleague if they have anything or go to TES (Times Education Supplement) and

	download the resources from there. Sometimes I make my own but not very often. The process is all very focused on what they have to achieve.
F	The school uses a whole school lesson proforma and allows each department to modify it in order to accommodate specific aspects or nature of the discipline. I plan in my head, starting by thinking about the previous lesson and some aspect that I need to reinforce or what to change or achieve. Because I have done so much work with Claxton, the proforma is used to 'order my thoughts, change the sequential activities, 'craft the lesson'. All the teachers use the plan as an aide-memoire, and ensure they have ownership, they use it in an authentic manner.
G	I start with the PowerPoint slide.
H	I have a folder, with tabs on each class. Each has termly planning, a box for each lesson, broken into three parts. I jot ideas in and plans or new ideas from training or new resources etc. Depending on the final outcomes, I can then plan for the next lesson. But I am always looking for new ideas, However there is always a structure of starter, main, plenary, but trying to add things throughout the week, rather than sit down and plan a lesson.
I	I start by thinking about the lesson; this could include notes scribbled on a piece of paper. I then go straight into 'design and making' the resources, I like this bit the most, as it is the creative part. I tend to plan the resources around a loose thread of the learning objectives, and then when the resources are made I tighten the learning objectives up. I do not fill in a lesson plan unless I am being observed, they are no help at all and just a procedural process of filling them in. It is purely a tokenistic process and I don't enjoy it. I write my notes from one lesson to the next on my scheme of learning. I tend to follow the format - starter, activity and plenary. As a whole school we have to start with 'to know' or 'be able to do?'
J	1. inspiration creates an idea 2. that idea is worked into exemplar material 3. broken down in best way to teach it 4. resourced and put into sequence 5. written down (if time allows) otherwise in my head
K	Think it through, work out rough order of jobs, where are we in overall scheme. What needs doing, collecting, marking etc. and then write a couple of sentences in planner as a reminder, but mostly just in my head. Gut instinct.

L	What do I want the pupils to learn? – How? Jot down a basic overview of the lessons, with links to SoW, bigger picture, keywords etc. Think about resources, equipment needed Think of some fun activities and add into lesson.
M	'as a faculty'- group discussions, audit of skills in SoW, agreed as a group of professionals This creates a lesson plan – all teach to As an individual we then personalise it in a planner – diary linked to group Extra is in my head – that is what makes it better!
N	All done in planner as a spidergram or mass of notes visually! KS3 what do I want them to learn? How will they be inspired by D&T? What resources? Who will work best with whom for given activities (knowledge of students, A7GS and LSAs as read) List of possible activities – connect, starter, activities, content process, benefit, AfL and plenary.
P	Talk to wife / also a teacher to test out ideas (if big change then…) trial resources/create as and when evening and after school Trawl internet for ideas/clips etc. Feedback from previous lesson first WWW and pit falls, usually think on way home/lunch etc. Mental notes for next lesson, night before.
Q	As projects are repeated each year, we have own resources in place already (objectives/outcomes etc.) We tweak things as we progress to make things better but in reality there is very little planning for individual lessons unless we are being observed
R	Think about what they did last lesson. Progress grid to see who has done what. Ensure resources and equipment are ready before the lesson. NOTHING written down - all in my head. Ensure work and folders are out and I know what the learning outcomes are e.g. 'know', 'understand' and 'be able to'.
S	Day 1 – look at what the topic/task needs to be Day 2 - think in my head and start generating some ideas – visualising Day 3 – chat through my ideas with staff in my department Day 4 – write the lesson plan on computer. Spend the evening annotating with notes as my thoughts come together Day 5 - on day of lesson include any additional notes/plans by hand Sometimes this process is condensed into 24-48 hours

T	Project already outlined – look at note in diary of where pupils arrive at during the lesson Using project overview highlight where they need to get to this lesson – from this list can set objectives. Differentiate tasks to suite learners and think about resources.
U	Most lessons are planned through discussion with technician based on medium term plans, identifying the objectives and bouncing ideas around base on post lessons. New ideas often formed within 5 -10 mins. over coffee. All kept in note form and periodically added to long/medium term plans
V	Look at scheme of work – decide what you want to do/what next, decide how to do it, - ideas for end product and how to get there. Requirements to ensure smooth running (paper, scissors etc.) What skills will pupils learn, go back to scheme – does it fit in?
W	Look at what has been achieved in last lesson- and where I want students to get to. Then brief notes for my own plan before. I can make it fit school lesson plan proforma where I have to break my lesson up to fit boxes/titles.
X	I plan by think about my group – I think about what resources I already have at my disposal – model, video, demo, PPT. I think what students will buy into/learn from – I go do it. I 'sold' it if not I come up with something
Y	Use of planner/diary, work out week by week ahead, though SoW for each rotation, then write down resources needed in planners and equipment (look at SEN notes at beginning of each group for differentiation requirements) Record whole weeks lesson's/notes on diary sheet for myself and technician so that she can support organisation of lesson before hand (similar to our science technician's request form) If as a dept. we discuss new ideas for strategies I adopt them as a 'trial' approach and then will use or tweak.
Z	KS4 – logical thoughts of structure at random points between end of one lesson and beginning of the next e.g. in car/shower Try to plan overarching theme/context/coverage of the lesson on a Sunday night KS5 – content/themes/headings – specification KS3 – depends on progress of project
A1	I decide what the learning outcome should be. I then jot things down in my teacher planner, discuss with colleagues to bounce ideas. The planning takes place mainly in my head!! It will change/evolve over time, I will think of ideas when doing normal activities, and that may change any plans.

B1	Theory reference – SoW think of updating resources, visual quizzes or online quizzes Chunking – starter/re-cap (short or long term) Flipped lessons interesting, design task, incorporating collaborative work including peer assessment, mini plenarys built in. High level usage of IT/digital/online/VLEs
C1	I know my SoW, I know my students, I spend either a Sunday afternoon planning my weeks lessons or I evaluate immediately after (sometime during) and note plans for the next less in a teachers planner (I know my resources too!)
D1	The school uses a progress triangle, which replaces lesson plans. This must be shown to students at start of the lesson. Tasks, skills and outcomes are ticked off throughout the lesson. Students do a face, or colour green, orange, red to identify whether they have understood the skills.
E1	Consider the range of ability, talent, behaviour of the group and any needs, problems, inspiration requirements they are currently dealing with (in terms of D&T) and plan the next lesson to motivate, inspire and redirect the learning. Constantly trying to find new ways to inspire and motive and engage for creativity. Relating any current events to link to lesson e.g. Bangladesh factory and safety

APPENDIX Q: Pilot analysis pro forma Study 1

M

Lesson plan reference:

LP rationale:

Learning objectives:

Active verb ☐

Clear/well written ☐ Differentiated ☐ Student-friendly ☐ Measurable ☐

Planned teaching methods:

Planned learning opportunities:

Planned FA opportunities:

baseline info. gathered? ☐

Plenary:

Any learning captured? ☐

Method of capturing:

Views on learning:

APPENDIX R: Responses from validation check 1

Comments sent via email in response to the initial analysis

School A

"Thanks for the update.

It makes interesting reading.

I thought the last bit about how people plan was really interesting, fascinating actually".

School F

"Wow! - this suggests that DT teachers do not plan from a learning objective first.

It was also interesting to find out where learning objective stems come from.

I really think this is so interesting".

APPENDIX S: Exemplar of *ILS* assessment criteria

1 – ‘clear’ statements,

‘To be able to describe a product using CAFEQUE’

‘To be able to mark out your work to a tolerance of 1mm’

2 – ‘unclear’, confusing or ambiguous statements,

‘To be able to communicate designs effectively’

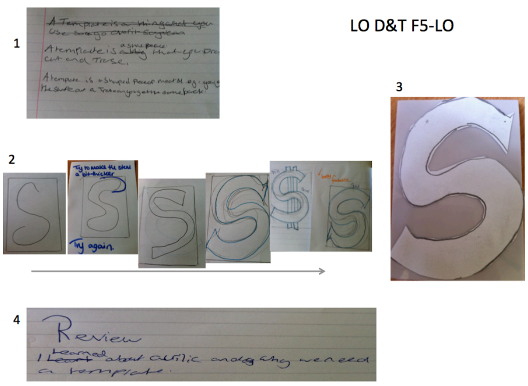
‘To have an understanding of the key safety points around the workshop’

APPENDIX T: Sets of *ELOs*

The table below provides reference to the lesson plan, the *ELOs* and the schools participating in the production of the *ELOs*.

School	Reference to lesson plan	Reference to learning outcome
A	D&T 2	D&T A2 - LO
	D&T 5	D&T A5 - LO
C	D&T 6	D&T C6 – LO
	D&T 7	D&T C7 - LO
F	D&T 1	D&T F1 - LO
G	D&T 3	D&T G3 – LO
	D&T 4	D&T G4 - LO

The learning outcomes for each lesson observation are presented below. The numbers corresponded to the sequence the learning outcomes were produced during the lesson. When two of the same number is shown, two or more examples of the *ELO*s were collected and are presented to provide additional detail.



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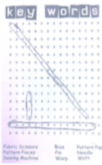

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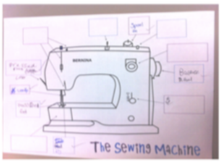

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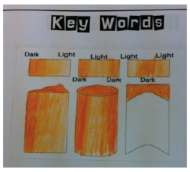

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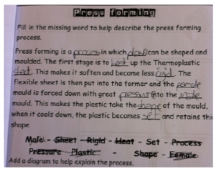

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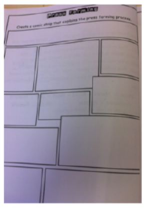

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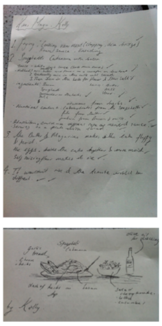

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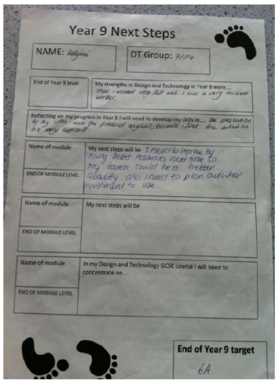

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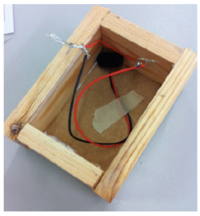

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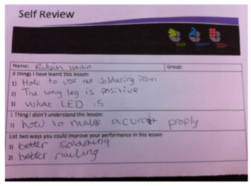

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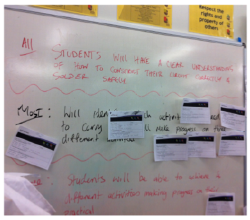

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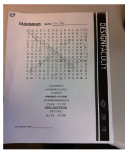

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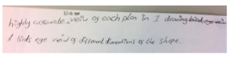

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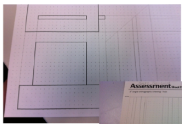
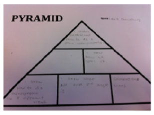


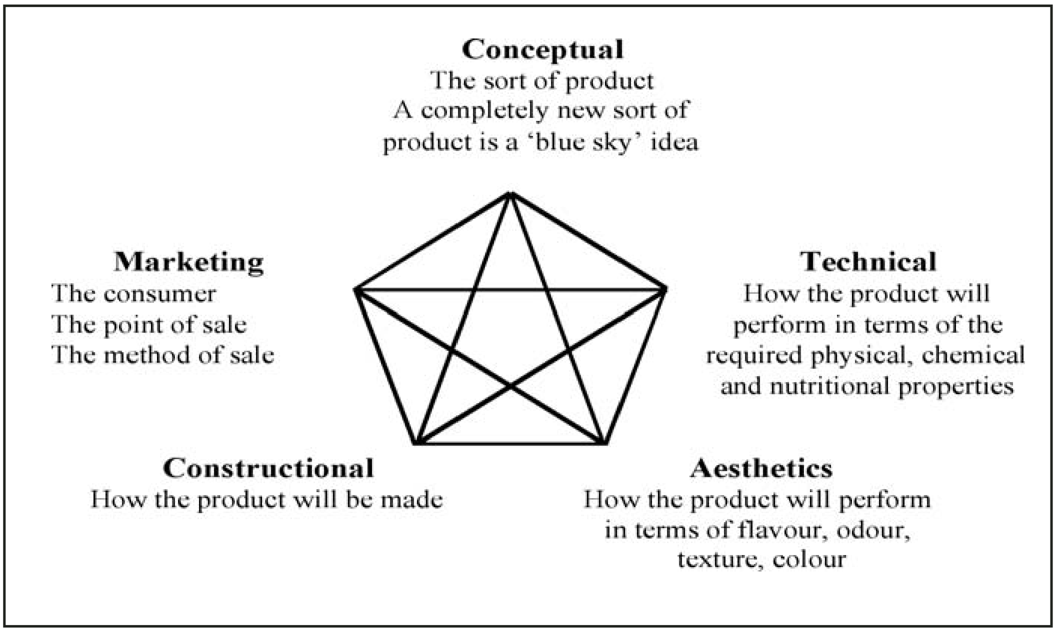
4


5


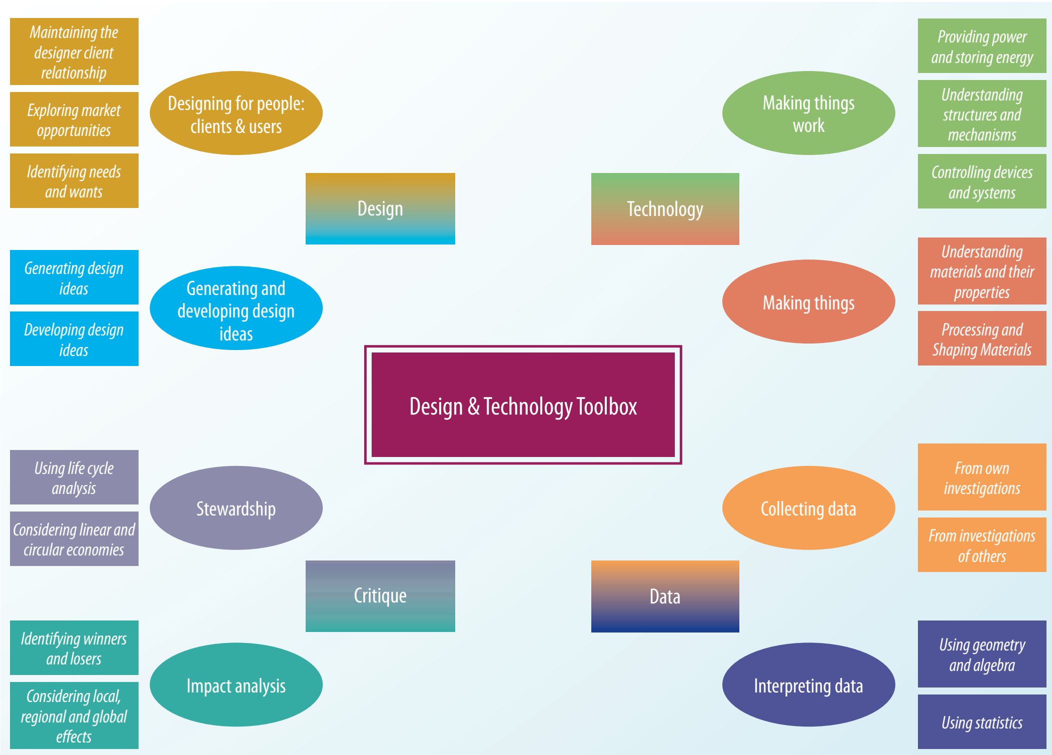
APPENDIX U: Design and Technology planning pro forma (Moreland, 2008)

<table>
<tr><td colspan="4">Task Definition:
Design & construct a mock-up of an attractive, portable, durable 3D-storage container to hold classroom maths equipment</td></tr>
<tr><td colspan="4">Key Aspects of Technological Practice
• Knowledge: Develop an understanding of the importance of the design process in developing a solution to storage problems;
• Capability: Develop & evaluate a suitable & practical storage solution for maths equipment taking into account attractiveness, portability & durability;
• Society: Identify the differing requirements for storing maths equipment for a variety of age groups of children.</td></tr>
<tr><th>Conceptual Learning Outcomes</th><th>Procedural Learning Outcomes</th><th>Societal Learning Outcomes</th><th>Technical Learning Outcomes</th></tr>
<tr><td>Understand:
• Design is an important factor in making storage containers.
• Planning includes criteria for making.
• Durability (takes lots of use over a long time).
• Nature of material to be stored needs to fit inside container.
• Optimisation of materials (don’t waste materials).
• Container needs to be suitable shape for storage space (needs to fit) & suitable capacity for equipment (right size).
• Portability (1 person can carry it and easily move it around room).
• Joining of materials (staple, glue, tape, dovetails, tabs).
• Purpose of a mock-up – to test out some variables.
• Containers can be identified with labelling.
• Containers should be aesthetically pleasing (eye catching).</td><td>• Examine current storage in classroom to identify main variables for designing suitable containers.
• Select an option that needs improving.
• Examine nets, 2D & 3D drawings.
• Make annotated concept, net, & 3D drawings and take account of capacity, durability, portability & attractiveness.
• Construct 3D mock-ups. Test and evaluate for shelf size, capacity & portability. Make modifications.</td><td>• Establish and understand classroom storage need/problem.
• Different people have different aesthetic responses – attractiveness of area & containers.
• Recycling material is important for minimising waste.</td><td>• Draw from different views, magnify some areas.
• 3D drawing.
• Draw lines, right angles, nets.
• Measure.
• Cut.
• Join by: folding, interlocking, overlapping, glueing, stapling, taping.</td></tr>
</table>

APPENDIX V: Design and Technology design decision pentagon (Rutland and Barlex, 2006: 7)



APPENDIX W: Design and Technology Tool Box (Morgan, Jones and Barlex, 2013: 10)



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APPENDIX X: Stage 1.1 Study 1

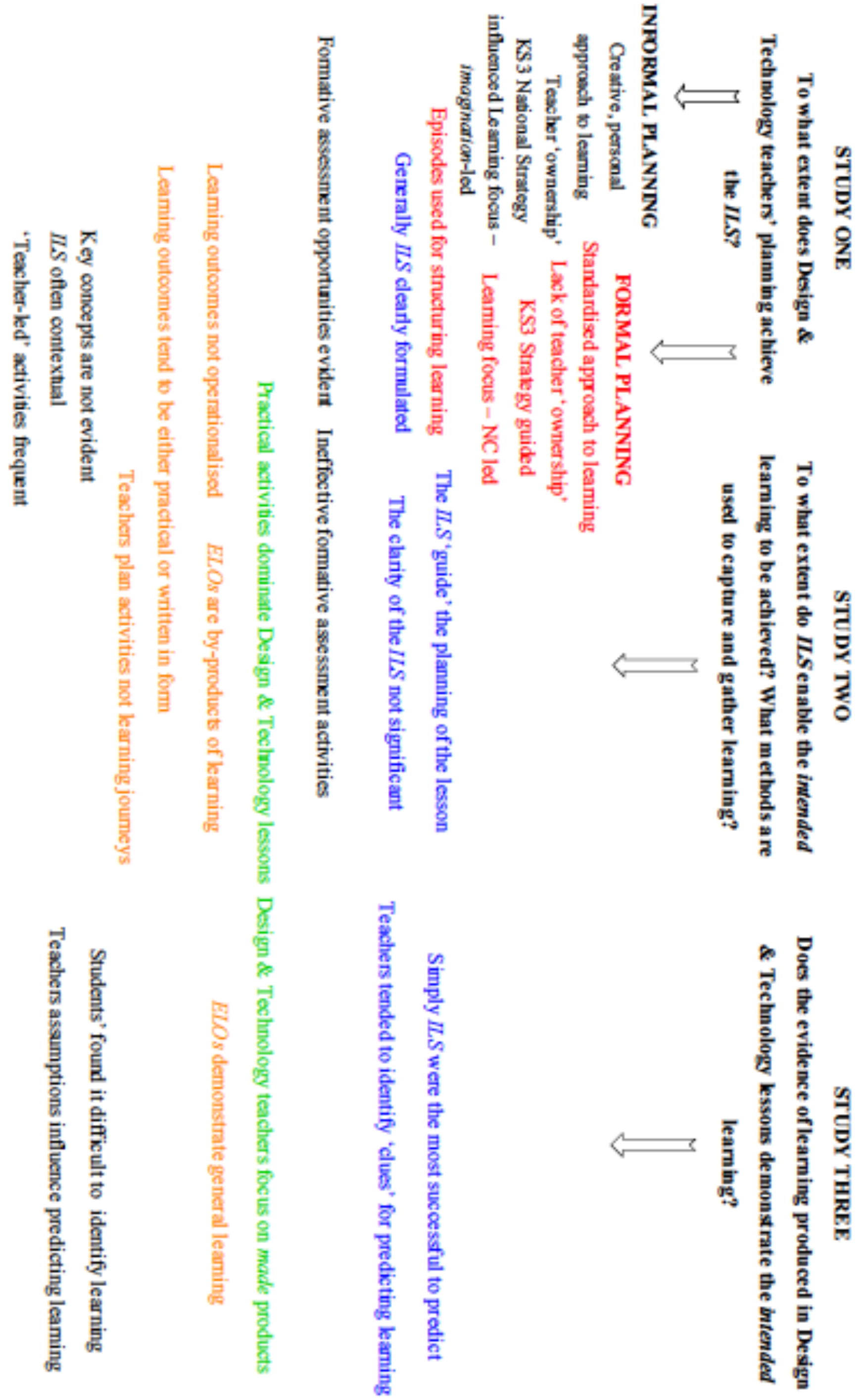
1.1 Stage one – Planning process analysis proforma

Lesson plan reference:	**Curriculum subject:**	
Main headings/titles/focus areas /section headings e.g. learning objective:	**Learning objectives:** Description: No. of: Clarity: Effectiveness: Examples of language used: Creativity ?	**Reference to learning outcomes:** Clarity: Type: Relation to learning objective: **Success criteria:** Yes/No Effective:
	Formative assessment techniques: No.of: Appropriate: **Plenary:** Effective:	**Overall comments (effectiveness, care, relation to learning outcomes):**

APPENDIX Y: Study 2 Observation schedule version 1.1

<table>
<tr><td>Focus of the learning opportunity:</td><td colspan="2">Learning/measurable outcomes:
-
-
-</td></tr>
<tr><td>Learning intentions (objectives, aims)
•
•
•</td><td>Success criteria:</td><td>Planned formative assessment opportunities:</td></tr>
<tr><td>Evidence of learning (notes):</td><td>Methods used to ‘capture’ the learning:</td><td>Evidence of views of learning:</td></tr>
</table>

APPENDIX Z: Figure 7.2 Overview of key themes to emerge from research findings



This diagram is colour-coordinated to identify and highlight key themes that emerged across the three studies.